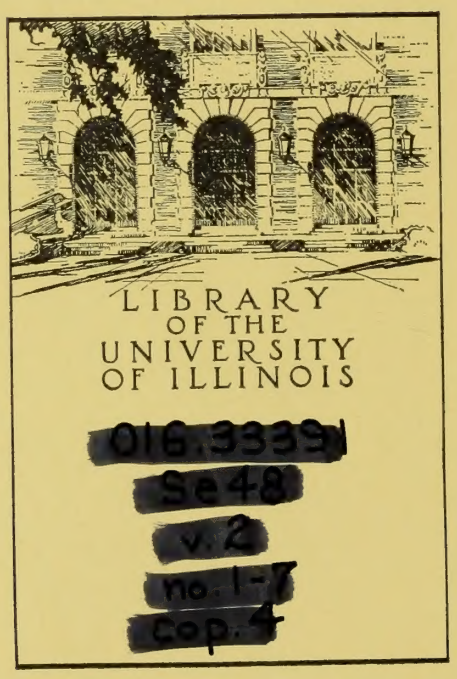

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VOLUME 2, NUMBER 1
JANUARY 1, 1969

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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VOLUME 2, NUMBER 1
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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

UNITED STATES DEPARTMENT OF THE INTERIOR
STEWART L. UDALL, Secretary

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FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

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To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions AND Suspensions

THE RELATION OF HUMIC COLOR TO IRON IN NATURAL WATERS,
Minnesota Univ., Minneapolis, Limnological Research Center.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-00385

02. WATER CYCLE

2A. General

THE EFFECT OF CLIMATE ON DRAINAGE DENSITY AND STREAMFLOW,
US Geological Survey, Water Resources Div., Washington, D. C.
Charles W. Carlston.
Bull of the Int Ass of Sci Hydrol, Vol 11, No 3, pp 62-69, 1966. 8 p, 1 fig, 2 tab.

Descriptors: *Climatic zones, *Drainage density, *Streamflow, Recharge, Precipitation intensity, Runoff, Evapotranspiration, Base flow, Groundwater recharge, Temperature, Arid climates, *Storm runoff, *Rainfall-runoff relationships, Semiarid climates, Arid climates, Alluvial channels, Floods, Petrography, Flow rates.

Recharge is dependent upon the amount and distribution of precipitation, less the amount of loss in direct overland runoff and evapotranspiration. Examination of the relation of drainage density to base flow in the 15 basins studied gave evidence that base flow was affected by precipitation or recharge (a climatic variable), while varying inveresly with drainage density. Annual precipitation decreased to negligible amounts in passing through the sequence of increasing aridity in Steppe and Desert climates. Drainage density was a function of flood runoff intensity whether the magnitude of runoff intensity was due to precipitation intensity or terrene transmissibility. In semi arid and desert climates of the western and southwestern United States, recharge to the water table occurred only during exceptionally wet and cool winters or along flooded alluvial ephemeral watercourses at times of exceptional storms. These regions were characterized by extremely great variations in flood runoff and drainage density. There were great differences between the barren, angular, fine textured mountain ranges and the broad, smooth and aggrading depositional bolson floors of the intermountain basins. (Blecker-Ariz)
W69-00157

TIME SERIES ANALYSIS,
U. S. Geological Survey, Arlington, Virginia.
N. C. Matalas.
Water Resources Research, Vol 3, No 3, pp 817-829, Third Quarter 1967. 13 p, 28 ref.

Descriptors: *Time series analysis.
Identifiers: *Serial correlation, *Generating process, Hydrologic events, Stationary time series, Nonstationary time series.

A characteristic feature of hydrologic events is that they are not independently distributed in time. The degree of linear dependence between events that are K time units apart is measured by the serial correlation coefficient. This correlation, which tends to decrease with an increase in K, is attributed to storage processes in the atmosphere or within the drainage basin. The correlation measures the degree of redundancy of information yielded by each hydrologic event. This redundancy implies that statistical parameters computed from a sequence of events are less reliable than is indicated by the sequence length. Hydrologic sequences are formulated in terms of generating models to account for serial dependence between events, to allow prediction of events at future time points, and to assess the effect of serial dependence on hydrologic studies. (Seneca-Rutgers)
W69-00197

PROGRAM FOR ESTIMATING RUNOFF FROM INDIANA WATERSHEDS, PART I: LINEAR SYSTEM ANALYSIS IN SURFACE HYDROLOGY AND ITS APPLICATION TO INDIANA WATERSHEDS,
Purdue Univ, Lafayette, Indiana.
D. Blank, and J. W. Delleur.
Technical Report No. 4 Purdue University Water Resources Research Center. August 1968, 179 pages, 10 tab, 49 fig, and 78 ref.

Descriptors: *System Analysis, Input-output analysis, Hydrograph analysis, *Rainfall-runoff relationships, Watersheds, Base runoff, Rainfall excess, Storm runoff, Harmonic analysis, Frequency analysis, Hydrologic models, Synthetic hydrology, Analog models.
Identifiers: Linear system, Impulsive response, Convolution integral, Laplace transform, Fourier transform, Input matrix, Output vector, Kernel vector.

Rainfall-runoff relations were expressed by the convolution integral. The kernel function was evaluated by Fourier transform, Laplace-Gamma and Direct methods. Three analytical examples (known kernels) were analyzed. Data of 1059 storms from 55 Indiana watersheds ranging from 3 to 296 sq. mi. were assembled. The results indicated that for a third of the storms oscillatory kernels resulted. Oscillations were not necessarily due to nonlinearities but can arise from random errors in the data. Regardless of the shape of the kernel, output reproduction was accurate. Kernels from a watershed varied from storm to storm. These differences can be described in terms of time lag and maximum ordinate, and are indicative of system nonlinearity. Grouping of dimensionless kernels according to the above mentioned parameters is the basis for a suggested method of prediction, using trend relationships between maximum ordinate and base time, and between the former and time lag. Harmonic analysis of stage recorder response was presented, with the conclusion that for all natural storms no significant signal deformation is expected. Design and construction of an electronic analog simulator for rainfall-runoff studies were described. Preliminary investigation indicated that the analog is linear and can be used to estimate response to natural storms. (Blank-Purdue)
W69-00210

ANALYSIS OF HYDROLOGIC SYSTEMS,
Virginia Polytechnic Institute, Blacksburg, Water Resource Center.
T. T. Chiang, and J. M. Wiggert.
OWRR Project No. A-013-VA, Water Resources Research Center, Bull. 12, May 1968. 5 p.

Descriptors: *Hydrology, *Runoff, *Floods, *Similarities, Systems analysis.

The techniques of process dynamics analysis or frequency response analysis were applied to the response to precipitation excess of watersheds. Rectangular, impervious model basins were tested for response characteristics and the input-output (rainfall-runoff) data were manipulated to provide the standard parameters of the transfer functions. These parameters were then used in an analog simulator for a digital computer to test the transfer function. The method of analysis was also applied to natural hydrologic systems, using data from the Detroit, Michigan area, after reducing the data to that of precipitation excess and surface runoff. The conclusion of the analysis is that the method reproduces flows quite well. A nonlinear, second-order equation was found to represent the runoff of the model basins. A linear, second-order equation, in which the damping coefficient is very nearly unity (the critically damped case), was found to be a fairly good description of the flows of natural basins. (Wiggert-Va Tech)
W69-00226

WATER POTENTIAL STUDIES OF LUNI BASIN,
Central Arid Zone Research Inst., Johdpur, Rajasthan, India.
V. V. Dhruvanarayana.
Ann of Arid Zone, Vol 4, No 2, pp 99-109, Sept 1966. 11 p, 2 tab.

Descriptors: *Groundwater, *Surface waters, Water resources, Rainfall disposition, Temperature, Equations, *Water balance, Climatic data, Water utilization, Reservoir storage, Rainfall-runoff relationships, *Numerical analysis.
Identifiers: India, *Water potential.

Water potential figures obtained by different methods were compared to get reliable figures of surface and groundwater potentials of the Luni Basin. Figures of mean and maximum daily rainfall and mean and maximum temperatures up to 1950 were utilized. The methods used included Thornwaite's, Khosla's, Blaney's and Strange's. Approximately equal values of total water potential were obtained with the Thornwaite and Khosla methods and the mean value of the two was considered the probable water potential. (Affleck-Ariz)
W69-00372

2B. Precipitation

ANNOTATED BIBLIOGRAPHY OF ESSA PUBLICATIONS OF HYDROMETEOROLOGICAL INTEREST,
Weather Bureau, ESSA, Office of Hydrology.
J. L. H. Paulhus.
ESSA Technical Memorandum WBTM HYDRO-6, November 1967, Second Edition, 27 p.

Descriptors: *Bibliographies, *Hydrology, *Meteorology, Climatology, Clouds, Dew point, Droughts, Evaporation, Floods, Hydrologic cycle, Precipitation (Atmospheric), Radar, Radiation, River forecasting, Runoff, Snow, Storms, Streamflow, Temperature, Water management (Applied), Winds.
Identifiers: *Hydrometeorology, Relative humidity, Water supply forecasts.

Lists 105 ESSA publications pertinent to the joint fields of hydrology and meteorology. This bibliography is especially intended to serve the engineer by bringing to his attention the publications of hydrometeorological material that he often requires. General subjects include: Climatological Observations and Data/Clouds, Liquid Water Content in Storms/Dewpoints, Maximum persisting/Drought/Evaporation /Floods/Hydrologic Cycle/Networks, Hydrologic/Precipitable Water/Precipitation, computed/Precipitation, Depth-Area-Duration Analysis/Precipitation, Excessive and Maximum Observed/Precipitation, Mean and Normal/Precipitation Measurements/Precipitation, Probable Maximum/Radar (Hydrologic Uses)/Radiation, Solar and Sky/Rainfall Frequency/Relative Humidity/ River and Flood Forecasting/River Stages/Runoff/ Snow/Station History/ Storms (thunderstorms, tropical storms, hurricanes)/Storm Surges/Streamflow Frequency Analyses/Temperature/Wat Management/Water Supply Forecasts/Wind. (Strahl-ESSA)
W69-00001

TIME ANALYSIS OF RAINFALL ON AN URBAN CATCHMENT,
Auckland Univ., New Zealand.
V. J. Bidwell.
J of Hydrol (New Zealand), Vol 6, No 2, pp 74-79, 1967. 6 p, 3 fig.

Descriptors: *Rainfall, *Rainfall intensity, Rain gages, Runoff, Mass curves, *Probability, *Correlation analysis, Rainfall disposition.

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For urban catchments, time of concentration, runoff, and other time parameters involved is relatively short and thus rainfall increment must be short - in this analysis it was 10 minutes. A year of 10-minute rainfall values was extracted from autographic records for Albert Park, Auckland, New Zealand. The record was analyzed in order to obtain the critical time lag which was a measure of rainfall persistence. Probability of occurrence of any rainfall event was assumed to be independent of any other event. The data was punched on IBM cards for computer use. Rank-correlation coefficient were used as a test for rainfall persistence. The length of record used was not of sufficient duration to give conclusive evidence of storm lengths or any seasonal variations. Large differences occurred in sets of data analyzed in the one-year record. Whether differences were due to seasonal changes or other factors was not readily apparent. It was intended that the analysis serve as an indication of the application of the techniques to rainfall records. Techniques used in the study could be applied to arid climates where rainfall persistence and probability of occurrence are important. (Blecker-Ariz)
W69-00156

RAINFALL GRADIENTS IN WARM SEASON RAINFALL,
Illinois State Water Survey, Urbana.
F. A. Huff.
J of Applied Meteorol, Vol 6, No 2, pp 435-437, April 1967. 3 p, 2 fig.

Descriptors: Rainfall, *Rainfall disposition, Storms, Meteorology, *Rain gages, Equations, Seasonal, *Meteorological data, Variability.

Little quantitative information has been published on distribution of rainfall gradients in various types of storms. The purpose of the study was to provide quantitative information on rainfall gradients in warm season storms in the Midwest. Records from two dense networks of recording raingages in central Illinois provided data for the study. Two equations provided the means for obtaining quantitative estimates of rainfall in unstable, shower-type precipitation of spring to fall. The derived relationships were applicable to total storm rainfall for storm durations of 24 hours or less. Results were considered a reasonable approximation of daily rainfall relations since the storm definition resulted in most storm days having a single storm period. (Blecker-Ariz)
W69-00166

METEOROLOGY OF MAJOR STORMS IN WESTERN COLORADO AND EASTERN UTAH,
Weather Bureau, ESSA, Office of Hydrology.
R. L. Weaver.
ESSA Technical Memorandum WBTM HYDRO 7, January 1968, 75. 40 fig, 14 tab, 12 ref.

Descriptors: Advection, Air circulation, Air masses, Climatology, Hydrology marine air masses, Meteorology, Moisture, Mountains, Orography, Precipitation (Atmospheric), Rainfall disposition, Rainfall intensity, Storms, Storm structure, Synoptic analysis temperature, Topography, Weather patterns, Winds.
Identifiers: Western Colorado, Eastern Utah, 500-mb patterns.

Meteorology of Major Storms in Western Colorado and Eastern Utah. The 42 most intense general storms in eastern Utah and western Colorado since 1899 are studied in relation to the observed or estimated broadscale upper air circulation patterns and sources of moisture. The report summarizes individual analyses of the storms. Storms are typed by reference to the behavior of the 500-mb patterns. The role of upper Lows in transporting moisture is emphasized. Indices are developed which evaluate storm moisture, temperature and influence of topography. The relative importance to the precipitation sequence of peak moisture versus proximity of upper Lows or troughs is compared. Moisture source regions are related to storm type and season. Local topographic effects are summarized by upper wind direction. (Strahl-ESSA)
W69-00270

2D. Evaporation and Transpiration

USE OF ATMOMETERS IN ESTIMATING EVAPOTRANSPIRATION,
California State Department of Water Resources, Sacramento.
John W. Shannon.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR3, Pap 6120, pp 309-320, Sept 1968. 3 fig, 4 tab, 6 ref.

Descriptors: *Evapotranspiration, *Instrumentation, *Atmometers, *Evaporation pans, Calibration, Vegetation effects, Agricultural engineering.
Identifiers: *Crop coefficients (Evapotranspiration), Climatological data.

Studies conducted by the California Dept of Water Resources during the past 10 yr show that Livingston black and white spherical atmometers provide a practical means of estimating monthly and seasonal evapotranspiration. The difference of evaporation between the black and white atmometers is affected primarily by shortwave energy, whereas evaporation from either the black or white atmometer provides an index of the total amount of energy available for evapotranspiration. Various studies have been made, the results of which indicate that the type of background such as bare ground, dry range, or irrigated pasture has little effect upon the difference in evaporation between the black and white atmometers. Height above the ground or crop likewise has little or no effect upon the difference of evaporation. Monthly crop coefficients have been developed for some of the principal crops in the California Central Valley, which provide evapotranspiration estimates consistently as good or better as can be obtained using coefficients developed from United States Weather Bureau Class A evaporation pan data. (Knapp-USGS)
W69-00105

THE LIMITATION OF TEMPERATURE BY EVAPORATION IN HOT CLIMATES,
Australia Commonwealth Sci. Indus. Thech. Org., Aspendale, Victoria.
C. H. B. Priestley.
Agr Meteorol, Vol 3, No 3/4, pp 241-246, May 1966. 6 p, 3 tab.

Descriptors: Temperature, Evaporation, Arid climates, *Climatic data, *Plant growth, Environmental effects, Soil moisture, Heat transfer, *Heat balance, Leaves, *Air temperature.
Identifiers: *Hot regions.

Many factors affecting plant growth and well-being are sensitive to the temperature of the plant and its environment, particularly at high temperatures. A review of data was done to see what are the general principles which govern the maximum temperatures which can be obtained in the environment of a growing plant, plentifully supplied with moisture. A resume of heat balance was given. A climatic evaluation was done for 1850 stations distributed over the land surfaces of the world. Data collected by Linacre have indicated a reversal of heat transfer between leaf and air in the vicinity of 33 deg C for thin-leaved plants exposed to bright sunshine. An alternative view advanced in the paper and supported by a climatic study was that the phenomenon was quite general and that 33 deg C represents the maximum temperature attained by the air over any extensive freely evaporating surface which is naturally exposed. (Blecker-Ariz)
W69-00146

ESTIMATES OF POTENTIAL EVAPORATION USING ALTERNATIVE DATA IN PENMAN'S FORMULA,
Commonwealth Sci. Indus Research Org., Canberra, Australia.
E. A. Fitzpatrick, and W. R. Stern.
Agr Meteorol, Vol 3, pp 225-239, 1966. 16 p, 3 fig 2 tab, 23 ref.

Descriptors: *Evaporation, *Radiation, Vapor pressure, Air temperature, Wind velocity, Seasonal, Instrumentation, Equations, Data collections.
Identifiers: *Penman's formula, Australia.

At Kununurra, Western Australia which has an environment with a wide seasonal range of radiation and vapor-pressure deficit, the energy and aerodynamic components of Penman's evaporation formula were calculated daily for a year. Reference values for the aerodynamic component were calculated from wet- and dry-bulb temperatures and windspeed using a relationship defined by Penman. Total radiation and relative duration of sunshine were found to be effective alternative sources of data for the energy component. Daily Piche and tank evaporimeter data were found to be satisfactory alternatives to the aerodynamic component. The minimal instrumentation needed to determine potential evaporation was a net radiometer, Piche evaporimeter and maximum and minimum thermometers provided a suitable relation between the Piche and aerodynamic component existed. The use of inappropriate constants in the Penman formula was probably a greater source of error when determining potential evaporation than the deficiencies inherent in a particular type of instrument, e g, a sunshine recorder. (Blecker-Ariz)
W69-00161

HYDROLOGIC PROPERTIES OF SEVERAL UPLAND FOREST HUMUS TYPES IN THE LAKE STATES REGION,
Michigan State Univ., East Lansing, Dept of Forestry.
Wade L. Nutter.
OWRR Report A-017-Mich., Ph.D. Dissertation, 147 p, 27 fig, 7 tab, 42 ref.

Descriptors: Humus, *Forest soils, *Evaporation, Unsaturated flow, *Soil water, Mulching, *Infiltration, Temperature, Humidity, Radiation, Diffusivity, Percolation, Soil water movement, Soil physics, *Hydrologic properties, Water loss.
Identifiers: Lake States, Humus-soil complex, Forest hydrology.

Ten sites were sampled that included a variety of soil and forest conditions and humus varients of mull, duff-mull, and mor. Rates of evaporation for undisturbed cores of the humus-soil complex, 16.5-cm diameter and 25.4-cm deep, were determined in controlled environment chambers by weight loss and water redistribution by gamma radiation. The humus types were separated by their hydrologic properties into four groups, each independent of inter-site mineral soil variation. Evaporation during a 50-day period was at a continuous falling rate lower than the water transmitting properties of the humus-soil complex and the mors lost a greater fraction of the initial water content than either the mulls or duff-mulls. Water flowed against the water content gradient during evaporation in response to an assumed matric suction gradient. The F horizon ceased to lose water between 16 and 30 days but the H horizon continued to lose water at a decreasing rate for the entire period of evaporation. During simulated rainfall the F and H horizons resisted wetting and water advanced as a wetting front in the mineral soil maintaining the nonuniform shape of the initial water content profile. (Author)
W69-00221

PAN EVAPORATION AND EVAPOTRANSPIRATION FROM CLIMATIC DATA,
Utah State Univ, Logan.
Jerald E. Christiansen.

J Irrig and Drainage Div (ASCE), Vol 94, No IR 2, Proc Paper 5988, pp 243-265, June 1968. 23 p, 13 tab.

Descriptors: *Evaporation pans, *Evapotranspiration, *Climatic data, *Mathematical models, Equations, Data collections, *Analytical techniques, Temperature, Solar radiation, Wind velocity, Humidity, Elevation.

A formula was developed at Utah State University for estimating pan evaporation from extraterrestrial radiation and climatic data. This formula utilizes climatic data of the type most readily available. Tables are presented to simplify the application of the formula where electronic computers are not used. Three formulas for estimating evapotranspiration for several agricultural crops using as the principal parameters either extraterrestrial radiation, pan evaporation or measured incident radiation, together with climatic data were also presented. The planning and design of irrigation systems in arid regions requires, at the outset, an estimate of water requirements which this formula can help to supply. (Affleck-Ariz)
W69-00362

EVAPORATIVE WATER LOSSES OF SOME SMALL AUSTRIALIAN LIZARDS,
Michigan Univ, Ann Arbor.
Willian R. Dawson, Vaughan H. Shoemaker, and Paul Licht.
Univ. of Western Australia, Nedlands Affiliate Inst.
Ecol, Vol 47, No 4, pp 589-594, 1966. 1 fig, 2 tab.

Descriptors: *Evaporation, *Water loss, Animal physiology, Arid climates, *Metabolism, Weight, Temperature, Ecology, Environmental effects, Reptiles.
Identifiers: Australia, *Lizards.

Three Australian lizards: Amphibolurus ornatus (agamidae), Gehyra variegata (Gekkonidae), and Sphenomorphus labillardiere (Scincidae) were compared with respect to water loss in a dry atmosphere. At 20 deg C the rates of total water loss for the unrestrained A ornatus, G variegata and S labillardieri averaged 1.9 g (100 g day) -1, 3.0 g (100 g day) -1 and 6.8 g (100 g day) -1 respectively. These figures represented evaporative water loss primarily and not metabolic activity. At 20 deg C and 30 deg C the water loss which was primarily of pulmonary origin of A ornatus averaged lower than that of the other two species. Cutaneous loss at 20 deg C comprised 70% of evaporative loss by A ornatus and G variegata and 41% of S labillardieri. At 30 deg C these percentages were lower. (Affleck-Ariz)
W69-00364

THE USE OF WATER BY COTTON CROPS IN ABYAN, SOUTH ARABIA,
Empire Cotton Growing Corp., Namulonge, Uganda.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00367

EVAPORATION OF WATER FROM SOILS AS INFLUENCED BY DRYING WITH WIND OR RADIATION,
U. S. Dept. of Agriculture, Fort Collins, Colorado.
R. J. Hanks, H. R. Gardner, and M. L. Fairbourn.
Soil Sci Soc of Amer, Vol 31, No 5, pp 593-598, Sept-Oct 1967. 6 p, 12 fig, 3 tab.

Descriptors: *Evaporation, *Winds, *Radiation, Air temperature, Soil temperature, Vertical migration, *Soil moisture, Arid lands, Thermocline, Drying, Soil profiles, Soil water movement, *Moisture content.

Evaporation of water directly from the soil accounts for loss of a large part of the precipitation received in arid parts of the world. A study was done to determine relative importance of temperature gradients in evaporation of water from soil. Water was evaporated from soils using wind and radiative drying that would produce different temperature gradients of various magnitudes and direction. When soils were compared for periods, absolute magnitude of the slope of the water content profile was greater at the bottom of the column for silt loam than for loamy sand or sand. The reverse was true near the soil surface. Temperature profiles for the three soils were similar and data from radiated columns showed an increase of temperature with depth from 0.5 to about 6 cm at 1 day and then a decrease with depth below 6 cm. Evaporation for the second day until the end of the run was 1.22, 0.91 and 1.41 times higher for wind than for radiation treatment of silt loam, loamy sand and sand soils respectively. (Blecker-Ariz)
W69-00378

SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGEBRUSH WITH 2,4-D,
Rocky Mountain Forest and Range Experiment Station, Laramie, Wyoming.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00379

THE EFFECT OF SLOPE, ASPECT AND ALBEDO ON POTENTIAL EVAPOTRANSPIRATION FROM HILLSLOPES AND CATCHMENTS,
New Zealand Dept. of Scientific and Industrial Research, Soils Bureau.
R. J. Jackson.
J of Hydrol (New Zealand), Vol 6, No 2, pp 60-69, 1967. 10 p, 4 fig, 2 tab.

Descriptors: *Evapotranspiration, Energy gradient, Radiation, *Solar radiation, *Slopes, Evaporation, *Albedo, Equations, Stream flow, Water balance.
Identifiers: Catchments, Penman's formula, Aspect, *Energy balance.

Use of a radiant energy balance appropriate to slope, aspect and albedo of a hillslope or catchment, in estimation of potential evapotranspiration of Penman's method, was illustrated for horizontal surfaces and slopes of 10, 20, 30 and 40 degrees facing north, south, east or west and having albedos of 0.1 and 0.25. The energy-balance approach to estimation of evaporation, which is based on the principle of the conservation of energy, was discussed, using equations. Included also were solar radiation on slopes, net radiation and potential evapotranspiration. For a region with average annual rainfall of 50 to 55 inches, the data implied a considerable variation in potential annual surplus available for stream flow according to characteristics of a hill slope or a catchment area. For any particular combination of slope and aspect there was a 20% decrease in potential evapotranspiration as a result of change in albedo which occurred to a greater extent in the summer months. Slope and aspect had their greatest influence on potential evaporation at the equinox. Methods described in the study could be used to measure evapotranspiration from hillslopes and catchments in arid parts of the world. (Blecker-Ariz)
W69-00381

2E. Streamflow and Runoff

NEW ASPECTS OF RIVER RUNOFF CALCULATIONS,
Pub for U. S. Department of Commerce and National Science Foundation, Washington, D. C., by Israel Prog for Scientific Transl, Jerusalem.
A. G. Trestman.
Book, Transl from Russian, OTS61-11465, U. S. Dep of Commerce, 163 p, 1964. 14 tab, 54 fig, 92 ref, 3 append.

Descriptors: *Discharge measurement, *Stage-discharge relations, *Stream gages, *Gaging stations, *Hydrographs, Streams, Flowmeters, Flow rates, Runoff, Hydrology, Hydrologic data, Methodology.
Identifiers: *USSR, Hydrometeorological service, Discharge curves.

The methods of runoff measurement and computation in use in the USSR are given in a 163-page manual covering the full range of the problems of hydrometry. Novel proposals are made concerning methodology of analyzing hydrometric data. A detailed classification of discharge curves according to their degree of instability is supported by numerous practical examples to facilitate analysis of runoff. The general categories covered are: present hydrometric methods and their short-comings; classification of discharge curves by their degree of stability; relationship between runoff and stability of discharge curves as a basis for runoff-computation methods; and the task of the hydrometerological service in organizing and supervising hydrometric work. (Knapp-USGS)
W69-00084

WATER DISCHARGE DETERMINATIONS FOR THE TIDAL REACH OF THE WILLAMETTE RIVER FROM ROSS ISLAND BRIDGE TO MILE 10.3, PORTLAND, OREGON,
U. S. Geological Survey, Water Resources Division, Washington, D. C.
George R. Dempster, Jr., and Gale A. Lutz.
U S Geol Surv Water-Supply Pap 1586-H, 1968. 32 p, 10 fig, 2 tab, 6 ref.

Descriptors: *Discharge (Water), *Discharge measurement, *Stage-discharge relations, *Unsteady flow, *Tidal waters, Digital computers, Mathematical models, Hydrographs, Routing, Oregon.
Identifiers: Slope-discharge relations, Willamette River, Portland.

Existing limited information about the river flow at Portland is supplemented and the use of mathematical models for determining water discharge in a tidal portion of the Willamette River is evaluated. In addition to presenting flow parameters, the applicability of using mathematical models to determine the discharge for the Willamette River at Portland is demonstrated by comparing computed and observed discharges for short term records and by comparing daily computed and routed discharges for a partial water year. The routed discharges are based on summations of upland streamflows routed to Portland. Discharges computed by using the mathematical models compare satisfactorily with observed discharges, except during the period of backwater from the annual flood of the Columbia River. The flow resistance coefficients used in the models vary with discharge. Agreement of computed with routed daily mean discharges is fair; above 30,000 cfs, average differences between the two discharges are about 10% and below 30,000 cfs, computed daily discharges are consistently greater than routed discharges by as much as 25%. (Knapp-USGS)
W69-00112

SOME RUNOFF CHARACTERISTICS OF BRITISH RIVERS,
Hull Univ., England, Department of Geography.
R. C. Ward.
J Hydrol, Vol 6, No 4, pp 358-372, Aug 1968. 15 p, 8 fig, 1 tab, 5 ref.

Descriptors: *Runoff, *Rivers, *Hydrographs, *Streamflow, Rainfall-runoff relationships, Spatial distribution.
Identifiers: Britain.

Runoff data available for British rivers are reviewed and general characteristics of seasonal and spatial variation of flow are outlined. Short periods of record are lacking generally, so 10 yr records are compared statistically with 25 yr records to determine their correspondence. Mean annual flows differ by no more than 10%, mean monthly extremes show only one case of greater

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than 10% difference, and mean monthly minima show only a few large differences between 10 and 25 yr records. Of 37 rivers studied, 29 show a low water period in summer and a maximum in winter. The remaining 8 show a slight tendency to have a secondary high in summer. Maxima occur in Dec in the northwest of Britain, but as late as March in the southeast. Mean minima occur in June in the northwest and as late as Oct in the southeast. These trends are explained by greater evapotranspiration in the south and east and less infiltration in the northwest. Rainfall, as well as runoff intensity, generally decrease from northwest to southeast. (Knapp-USGS)
W69-00120

SOME THERMAL CHARACTERISTICS OF TWO RIVERS IN THE PENNINE AREA OF NORTHERN ENGLAND,
Durham Univ., U. K., Dept. of Geography.
K. Smith.
J Hydrol, Vol 6, No 4, pp 405-416, Aug 1968. 12 p, 6 fig, 4 tab, 18 ref.

Descriptors: *Water temperature, *Rivers, Weather data, Hydrological data, Climatology.
Identifiers: River thermal characteristics, England.

Water temperature for the Wear and Tees Rivers and climatic data in the Pennine region of Northern England are compiled and analyzed. In the period of record of 4 yr, the thermal regime is compared at upstream and downstream sites on each river. River temperature and climatic data are presented graphically and in tables. The range in air temperatures is several times that of the water temperatures and the diurnal water temperature peak is progressively delayed relative to peak air temperature with distance downstream. (Knapp-USGS)
W69-00124

QUALITY OF SURFACE WATERS OF THE UNITED STATES 1960: PARTS 9-14, COLORADO RIVER BASIN TO PACIFIC SLOPE BASINS IN OREGON AND LOWER COLUMBIA RIVER BASIN.
U. S. Geological Survey.

U S Geol Surv Water-Supply Pap 1745, 607 p, 1968. 25 p text, 1 fig, 570 p analyses, 79 ref.

Descriptors: *Data collections, *Water quality, *Surface waters, *Colorado River Basin, *Columbia River Basin, Temperature, Turbidity, Chemical analysis.
Identifiers: *Fluvial sediment.

Records of chemical analysis, suspended sediment, and temperature are compiled for waters of the Colorado and Columbia River Basins for 1960. The data collected at the 368 stations on 250 streams include chemical analysis reports on silica, Fe, Ca, Mg, Na, K, carbonate, bicarbonate, sulfate, Cl, F, nitrate, B, pH, total dissolved solids, specific conductance, discharge, suspended load, and particle size analyses. (Knapp-USGS)
W69-00126

RECORDS OF NORTH-SIDE SPRINGS AND OTHER INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO, 1948-67,
U. S. Geological Survey.
C. A. Thomas.
Idaho Dep Reclam Water Inform Bull No 6, Aug 1968. 65 pp, 5 fig, 3 ref.

Descriptors: *Springs, *Inflow, *Discharge (Water), *Idaho, *Data collections, Hydrographs, Stream gages, Flow measurement, Discharge measurement.
Identifiers: Snake River, Idaho.

The average annual inflow of water to the Snake River, Idaho, between gaging stations at Milner and King Hill was determined to be 7,400 cfs during the water years 1910-1966. An estimated average of 5,900 cfs or 4.3 million acre-ft per yr issued from springs on the north bank and 1,500 cfs was from all south side sources. The spring flow is discharge from the Snake Plain aquifer which is recharged by seepage from streams flowing onto the Plain from the mountains to the north, seepage from Snake River and its tributaries, and infiltration of precipitation and irrigation water. All spring records collected from 1948 to 1967 are tabulated. A map shows locations of gaging stations and spring-measuring sites. Graphs show annual mean inflow, total spring flow, and the recharge index for the Snake River Plain. Hydrographs are drawn of spring flows, south bank inflow, total inflow, and recharge index below American Falls. (Knapp-USGS)
W69-00137

EVALUATION OF RUNOFF COEFFICIENTS FROM SMALL NATURAL DRAINAGE AREAS,
Kentucky Univ., Lexington.
Carlos Fix Miller.
Kentucky Univ, Water Resources Inst, Res Rep No 14, 1968. 112 pp, 25 fig, 14 tab, 36 ref.

Descriptors: *Rainfall-runoff relationships, *Flood forecasting, *Runoff coefficient, *Overland flow, *Small watersheds, Hydrograph analysis, Peak discharge, Infiltration, Rainfall intensity, Flood routing, Rainfall disposition, Time lag, Vegetation effects.
Identifiers: *Overland flow prediction.

Overland flow runoff coefficients are estimated from local watershed characteristics. The Stanford Watershed Model was used as a basis for developing a simplified empirical method for predicting flood peaks and frequencies for the design of small engineering structures such as highway bridges and culverts. The overland flow may be taken as some fraction of peak rainfall intensity. The coefficients of overland flow depend on the nature of the watershed surface, the probable soil moisture content, and the rainfall intensity. To predict the resultant streamflow, each overland flow hydrograph is routed downstream to a common point. The coefficient of resultant flow depends on areal distribution of overland flow, basin shape, drainage pattern, stream velocity, stream cross section, and tributary area. Equations and graphs are given to relate exposed surface index, percent impervious area, permeability, soil depth, and slope to coefficient of overland flow. Sources of information are soil surveys, topographic maps, and air photos. (Knapp-USGS)
W69-00139

AUTOCORRELATION AND SPECTRAL ANALYSIS IN HYDROLOGY,
Pittsburgh Univ., Pittsburgh, Pennsylvania.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00207

PROGRAM FOR ESTIMATING RUNOFF FROM INDIANA WATERSHEDS, PART I: LINEAR SYSTEM ANALYSIS IN SURFACE HYDROLOGY AND ITS APPLICATION TO INDIANA WATERSHEDS,
Purdue Univ, Lafayette, Indiana.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-00210

LOW-FLOW INVESTIGATIONS: TECHNIQUES OF WATER-RESOURCES INVESTIGATIONS,
U S Geological Survey.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-00245

RECESSION CHARACTERISTICS OF IOWA STREAMS,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-00262

INSTANTANEOUS UNIT HYDROGRAPH RESPONSE BY HARMONIC ANALYSIS,
Virginia Polytechnic Institute, Blacksburg, Water Resource Center.
J. M. Wiggert.
OWRR Project, Report No. A-014-VA, August, 1968. 5 p.

Descriptors: Harmonic analysis, *Instantaneous unit hydrograph, Surface runoff.

The method of harmonic analysis for the derivation of instantaneous unit hydrographs was studied with reference to its applicability to surface runoff prediction. It was noted that stability of harmonic coefficients was approached, as a minimum of twenty data points were available, though more were desirable. The need for a realistic separation of runoff and base flow was indicated. Most success at obtaining realistic instantaneous unit hydrographs was had when rainfall excess was confined to one or two measurement intervals. Very good correlations of predicted surface runoff were obtained with the observed surface runoff hydrographs when these instantaneous unit hydrographs were combined with more complex patterns of rainfall excess from storms of equal, overall duration. (Author)
W69-00273

2F. Groundwater

THE SOLUTION OF GYPSUM AND LIMESTONE BY UPWARD FLOWING WATER,
Nottingham Univ., Department of Geology, Great Britain.
R. J. Firman, and J. A. D. Dickson.
The Mercian Geologist, Vol 2, No 4, pp 401-408, Aug 1968. 8 p, 3 fig, 3 plate, 2 ref.

Descriptors: *Aquifers, *Gypsum, *Limestones, *Leakage, Groundwater.
Identifiers: *Leaky artesian aquifers, Evaporites, Nottinghamshire, Great Britain.

Examples are described of gypsum and limestone which have been dissolved by upward flowing water. It is suggested that such artesian and subartesian waters are more often agents of corrosion than is generally recognized. Gypsum nodules in the Newark Series of the Keuper Marl of Nottinghamshire commonly have solution holes on their bottom surfaces. Comparable holes are not found on the top surfaces of any nodules. Water commonly flows up out of the bottoms of gypsum quarries in which similar corrosion is seen on the undersurfaces of gypsum beds. Limestone quarries show the same features. In both examples the geologic structure consists of dipping strata containing alternating impermeable and soluble beds, which is a common occurrence with limestone and evaporites. Water moves upward out of the confined aquifer through solution openings in the soluble rocks. This is a common form of aquifer leakage in many artesian systems. (Knapp-USGS)
W69-00089

THE HYDROGEOLOGY OF AN INDUCED STREAMBED INFILTRATION AREA,
Connecticut University, Department of Geology and Geography, Storrs, Conn.
P. H. Rahn.
Ground Water, Vol 6, No 3, pp 21-32, May-June 1968. 12 p, 12 fig, 2 tab, 45 ref.

Descriptors: *Groundwater, *Induced infiltration, *Glacial drift, *Surface-groundwater relationships, Connecticut, Permeability, Pump testing, Streamflow, Observation wells, Hydrologic aspects, Hydrogeology.
Identifiers: *Induced recharge, *Streambed infiltration, Vertical permeability, Horizontal permeability, Eskers.

An evaluation is made of the hydrogeology and physical properties of an aquifer system in which induced infiltration is evident. Measurement of streamflow at 3 weirs on the Fenton River, Connecticut, shows that about 34% of the water withdrawn was induced streambed infiltration. The Connecticut University well field is in a sand and gravel ice-contact stratified drift aquifer which fills the valley 60-ft deep. Water level measurements in 30 observation wells show that cones of depression spread underneath the river and are influenced in shape by highly permeable, partly buried eskers. The water table is detached from the river in the area of influence of the wells because of the low vertical permeability of the streambed in comparison with the high horizontal permeability of the drift aquifer. The streambed cannot recharge the aquifers in the immediate area of pumping as fast as water is withdrawn. Time-drawdown pumping tests are not affected by the river. Thus, geology has a more important effect on aquifer yield than the pure hydrologic river-well system. Production is about 1 mgd. Quality is very good; no chlorination is needed. Data presented in topographic and surface geologic maps, water-table contour maps, tables, and sections. (Knapp-USGS)
W69-00111

GEOCHEMISTRY OF GROUNDWATER FROM UPPER CRETACEOUS-LOWER TERTIARY SAND AQUIFERS IN SOUTH-WESTERN VICTORIA, AUSTRALIA,
Geological Survey, Melbourne, Australia, Mines Department.
For primary bibliographic entry see Field 02K.
For abstract, see .
W69-00122

UNSTEADY SEEPAGE FLOW BETWEEN FULLY-PENETRATING TRENCHES,
Wisconsin Univ., Milwaukee, Dept. of Mech., and Northwestern Univ., Evanston, Ill., Dept. of Civil Eng.
Gabor Karadi, Raymond J. Krizek, and Hameed Elnagger.
J Hydrol, Vol 6, No 4, pp 417-430, Aug 1968. 14 p, 9 fig, 3 ref.

Descriptors: *Unsteady flow, *Groundwater movement, *Drainage effects, *Ditches, Dupuit-Forcheimer theory, Digital computers.
Identifiers: Matrix computation methods.

Unsteady seepage flow between 2 fully penetrating trenches is analyzed for homogeneous isotropic porous media characteristics. The solution may be extended to a cross-anisotropic porous medium. The method uses matrix mathematics to solve a non-linearized equation derived from Dupuit-Forcheimer approximations and the replacement of partial differential equations with a system of ordinary differential difference equations. The method may easily be adopted to computers and handles complicated boundary and initial conditions as well as allowing step by step treatment of the non-linearity of the differential equation. The results calculated are in better agreement with experimental results than are results obtained by the use of linearized field equations. (Knapp-USGS)
W69-00123

GROUND-WATER RESOURCES OF ACCOMACK AND NORTHAMPTON COUNTIES, VIRGINIA,
U. S. Geological Survey.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-00127

PRELIMINARY REPORT ON THE WATER RESOURCES OF THE KAHUKU AREA, OAHU, HAWAII,
U. S. Geological Survey, Honolulu, Hawaii.
K. J. Takasaki, Santos Valenciano, and A. M. Ho.
Hawaii Dep of Land and Natur Resources, Div of Water and Land Dev, Circ C39, Nov 1966. 33 p, 16 fig, 11 ref.

Descriptors: *Water resources, *Groundwater, *Hawaii, Rainfall, Basalts, Irrigation water, Saline water intrusion, Runoff, Isohyets, Ephemeral streams, Hydrographs.
Identifiers: Kahuku area, Oahu, Hawaii, Dike water, Potential water sources.

Groundwater is the source of all the water used in the Kahuku area because the rainfall, which ranges from 30 in. on the coast to 300 in. in the mountains, infiltrates rapidly and very little of the aggregate precipitation of 273,000 acre-ft per yr runs off. Most streams are perennial in the high parts of the area and some are perennial in their middle reaches where they are fed by groundwater discharge. Most streams are ephemeral in their lower reaches. In a 2-3 mile wide zone along the crest of the mountains, groundwater is impounded by basaltic dikes. Water levels in dike impoundments range from 10-1,000 ft msl. The water moves parallel to the dikes as well as through and over them. In coastal areas, basal ground water levels are within a few ft of sea level. Numerous wells tap the basal groundwater to irrigate sugar cane. Total groundwater draft is 29 mgd. There is some salinity increase from sea water intrusion and return of irrigation water. (Knapp-USGS)
W69-00130

PRELIMINARY REPORT ON THE WATER RESOURCES OF THE KAU DISTRICT, HAWAII,
U. S. Geological Survey, Honolulu, Hawaii.
Dan A. Davis, and George Yamanaga.
Hawaii Dep of Land and Natur Resources, Div of Water and Land Dev, Circ C27, Oct 1966. 25 p, 7 fig, 5 ref.

Descriptors: *Water resources, *Groundwater, *Infiltration, *Hawaii, Rainfall, Perched water, Basalts, Saline water intrusion, Runoff.
Identifiers: *Volcanic terrane, Kau area, Hawaii.

Groundwater and rainwater caught on roofs and rainsheds are the only water sources in the Kau area, which includes the slopes of Mauna Loa, Hawaii, because infiltration of the 15-125 in. annual rainfall into the highly permeable lava flows, ash, and tuff is so rapid that no streams are perennial. Groundwater is discharged principally from springs near the shore at the outcrop of the basal groundwater body; (visible spring discharge is 30-50 mgd). The basal water is brackish for a considerable distance inland in most of Kau. Pumpage is less than 3 mgd. Perched water occurs in lava flows in the uplands from Pahala to Naalehu and discharges in springs, seeps, and numerous water-development tunnels. Average total tunnel flow is 1-2 mgd, and many tunnels are abandoned because the water was used to flume cane, which is no longer done. A thick body of high-level groundwater is impounded to 230 ft above sea level by an undetermined geological structure near Pahala. A shaft with drilled wells taps the reservoir and about 1.5 mgd is pumped but the extent and potential yield of the reservoir are not known. (Knapp-USGS)
W69-00131

ON THE INFLUENCE OF THE POLDERING OF LAKE TOGO-IKE FOR THE TOGO HOT SPRING GROUP,
Japanese Society of Limnology, Otsu, Japan.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-00132

PHYSICAL PRINCIPLES OF WATER PERCOLATION AND SEEPAGE,
Technion-Israel Institute of Technology, Haifa, Faculty of Civil Engineering.
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-00135

WATER RESOURCES AND SURFICIAL GEOLOGY OF THE HOMER AREA, SOUTH-CENTRAL ALASKA,
U S Geological Survey.
Roger M. Waller, Alvin J. Feulner, and Donald A. Morris.
U S Geol Surv Hydrol Invest Atlas HA-187, 1 sheet, 1968. 3 map, 1 photo, 1 tab, 2 chart, 9 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Water quality, *Hydrogeology, Aquifers, Hydrologic data, Logging (Recording), Water levels, Springs, Water sources, Water yield, Specific capacity, Alaska.
Identifiers: Homer, Alaska.

The groundwater resources of the Homer area, at the southern end of the Kenai Peninsula, Alaska, are described. The use of surface water is not practical because of insufficient flow in nearby streams and long distance to an adequate supply. Most of the wells drilled into Cretaceous Kenai Formation at the lower altitudes yield less than 10 gpm. The largest recorded specific capacity was 0.25 gpm per ft. On top of the 1100 ft high escarpment north of Homer, wells in the Kenai Formation yield 50-100 gpm with a specific capacity of 1 gpm per ft. Quaternary sands and gravels yield about as much water as the Kenai Formation. No fresh water is available under Kenai Spit, where most of the area's industry is located. Groundwater is of the Na-Ca-bicarbonate type with as much as 30 ppm Fe and some combustible gas. Additional development of groundwater north of the escarpment seems feasible. The water in test holes is of good quality and contains 1-2 ppm Fe. Maps scaled 1:63,360 show location of wells and springs, water quality, and surficial geology. A cross section shows relative position of major physiographic and geologic units. (Knapp-USGS)
W69-00140

THE RELATIONSHIP OF FLOODING AND SALINE WATER TABLES,
S. T. Smith.
Western Australia Dept of Agr J, Ser 4, 7 (s), pp 334-335; 338-340, August 1966. 5 p, 4 fig, 2 photo.

Descriptors: *Flooding, *Saline water, Groundwater movement, *Water table, Base flow, Aquifers, Underground streams, Land clearing, Surface drainage, Valleys, *Saturated soils, Bores, Water properties, Water pressure, Confined water, *Seepage.

In Western Australia there are several ways in which salt manifests itself. The most serious and extensive of these is in the valley systems where shallow saline water tables occur. This type of salt problem is called 'valley waterlogging' and occurs in most of the flat valleys throughout Western Australia. Underground water movement studies were carried out in seven valleys. The studies consisted of drilling bores to various depths both across and down each valley to tap the underground water. Four areas of water characteristics were determined when the potential pressure of the water was measured. The aspects studied were: whether the water was confined, seasonal fluctuation of the water table, continuity of underground aquifers and the direction of flow. Studies indicated that it is the water entering the higher country and passing beyond the reach of plant roots and seeping into the valley that causes water tables. Water tables did not arise from flooding. Clearing the land had greatly accelerated rising water tables. Surface drainage would have little or no effect on rising water tables. (Blecker-Ariz)
W69-00159

RADIOMETRIC STUDIES OF THE FLORIDAN AQUIFER,
Florida State Univ., Tallahassee, Florida.
J. K. Osmond, and B. F. Buie.
Office of Water Resources Research, Project Completion Report A-005-FLA July 1968. 40 pp, 9 fig, 1 tab, 30 ref.

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Descriptors: *Uranium radioisotopes, *Tritium, *Florida, *Groundwater movement, Gravity studies, Seismic studies, Groundwater recharge, Aquifer, Radioisotopes.

Research under grant A-005-FLA of the Office of Water Resources Research has been concerned with three aspects of the Floridan aquifer near Tallahassee, Florida: (1) Data on the concentration of uranium and the variations of uranium isotopes (U-234/U-238) provide a method of estimating quantitatively the volumes of sources contributing to the aquifer. Both the techniques of isotopic analysis and method of data analysis have been developed to the point where general application to hydrologic problems seem desirable; (2) Data on the tritium content (H-3) of aquifer water can be used to study time dependent problems of infiltration and aquifer flow. More analyses are needed to complete this type of study, but a new liquid scintillation counting approach (conversion to benzene) has been developed; (3) The results of a study by geophysical methods of the aquifer strata were inconclusive in the case of seismic refraction, but gravimetric traverses suggest that information may be obtained concerning faults and caverns in the limestone aquifer. (Authors)
W69-00212

SUMMARY REPORT ON THE GROUND-WATER RESOURCES OF THE ANYANG CHON BASIN,
U S Geological Survey.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00239

GROUND-WATER RESOURCES OF SAN JACINTO COUNTY, TEXAS,
U S Geological Survey.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00240

ROLE OF GROUND WATER IN TEXAS WATER PLAN,
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00250

UNCONFINED AQUIFER CHARACTERISTICS AND WELL FLOW,
Engineering-Science, Inc., Oakland, Calif., and California Univ., Davis.
Houshang Esmaili, and Verne H. Scott.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR1, Pap 5872, pp 115-136, Mar 1968. 22 p, 6 fig, 3 tab, 25 ref.

Descriptors: *Groundwater movement, *Unsteady flow, *Aquifer characteristics, Hydraulic conductivity, Storage coefficient, Darcys law, Dupuit-Forcheimer theory, Injection wells, Withdrawal.
Identifiers: Unsteady radial flow.

Numerical solutions are developed for determination of aquifer characteristics and unsteady radial flow through injection wells in unconfined aquifers under constant drawdown and injection pressure conditions. These solutions are based on a numerical solution of the basic differential equation of flow. Appropriate dimensionless parameters are introduced to transform the basic differential equation of flow into an explicit form. Dimensionless graphical solutions are presented for the rate and accumulative volume of discharge and recharge and the radius of expansion of recharge mounds versus time for a range of draw-down and injection pressure values. Numerical examples are presented by applying these solutions to hypothetical field conditions. (Author)
W69-00251

CLIMATE AND STREAMFLOW OF PUERTO RICO,
U. S. Geological Survey, San Juan, Puerto Rico, Water Resources Division.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-00253

PROGRAMMING FOR PAVLOVSKY'S GROUND-WATER PROBLEM,
Oklahoma Univ., Norman.
George T. Papadopoulos, and Joakim G. Laguros.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR1, Pap 5840, pp 49-56, Mar 1968. 8 p, 6 fig, 1 tab, 4 ref.

Descriptors: *Groundwater movement, *Seepage, *Digital computers, *Computer programs, Aquicludes, Water level fluctuations, Irrigation, Drainage.
Identifiers: Pavlovskys method, Kuo method.

The amount of seepage and the free surface profile in an unconfined flow between two water bodies above an inclined impervious layer are highly dependent on the normal depth of flow. Pavlovsky's solution requires a rather time-consuming graphical method of calculating the value of the normal depth. The computer program presented not only reduces the time element but it also encompasses the rising surface and falling surface types of flow for values of slope greater and less than zero and for a range of headwater and tailwater values. This is made possible by using Kuo's method of false position, which is uniquely adapted to problems where the unknown function is expressed unavoidably in terms of the same unknown parameter. Variations in the length of the impervious medium are considered and 1 example is presented. (Author)
W69-00263

GEOLOGICAL STRUCTURE AND ITS EFFECT ON THE GEOTHERMAL HYDROLOGY OF SOUTHWESTERN HREPPAR, ICELAND,
Cornell Univ., Ithaca, N. Y., Geol. Sciences Dept.
George A. Kiersch, and L. N. Chaturvedi.
OWRR Project No. A-020-NY, Cornell Water Resources and Marine Sciences Center, August, 1968. 6 p.

Descriptors: *Geological structures, *Geothermal hydrology, Hot springs.

The report is a summary of results of a field investigation on geothermal hydrology in southwestern Hreppar, Iceland. A Ph.D. thesis in preparation will discuss in detail the structural pattern and the mechanism by which it controls the localization of hot springs. The investigations to date indicate the following results: (1) most of the water at boiling temperatures occurring as hot springs in southwestern Hreppar is meteoric in origin; (2) the water circulates through a system of faults and through permeable zones between basalt flows, the water moves to several thousand feet below the surface and is heated by abnormally high geothermal gradient; (3) rise of this heated water back to surface is carried out again through a system of faults which slowly enlarge into convection conduits; and (4) the localization of hot water in the form of hot springs is controlled by a system of faults which are aligned in three major directions. (Neno-Cornell)
W69-00309

DRAWDOWNS DUE TO PUMPING FROM STRIP AQUIFERS,
Pakistan Irrigation and Power Dept., Lahore.
S. M. H. Bokhari, J. K. Strachan, and A. K. Turner.

J Irrig and Drainage Div (ASCE), Vol 94, No IR 2, Proc Paper 5981, pp 233-242, June 1968. 9 p, 4 fig, 1 tab. Melbourne Univ., Parkville Australia Affiliate Inst.

Descriptors: *Drawdown, Pumping, Wells, *Aquifers, Recharge, Equations, *Permeability, *Theoretical analysis, Analog models, Boundaries (Surfaces), *Membranes, Mathematical models.
Identifiers: *Strip aquifers, Membrane analogs.

Drawdown patterns due to pumping from wells in long narrow (strip) aquifers were dependant mainly on the type of side boundary (recharge, impermeable). A theoretical solution was developed for an idealized confined aquifer with impermeable boundaries, and the results compared favorably with those obtained from complimentary tests using a membrane analog. Solutions were also given for a simpler case of recharge boundaries. Either the mathematical or membrane solutions are thought to be suitable for field purposes. (Affleck-Ariz)
W69-00377

2G. Water in Soils

SOME PROBLEMS OF SOIL HYDROLOGY,
Academy of Sciences, USSR, V V Dokuchayev Institute of Soil Science.
Yu. F. Gotshalk.
Pochvovedeniye, No 11, pp 100-106, Nov 1967. 6 p, 5 tab, no ref. Soviet Soil Science, Transl by Scripta Technica, Inc, pp 1520-1526, Aug 1968.

Descriptors: *Soil investigation, *Crop production, *Soil moisture, *Methodology, Percolation, Permeability, Translations.
Identifiers: *Soil hydrology, *USSR.

The practical and theoretical significance of soil hydrology is briefly reviewed in relation to the effect of soil moisture on crop productivity in the USSR. Experiments were conducted on the percolation of water through dead roots of lowland peat soils, silty clays, and soils with manure and other organic additives. Results are graphed of an experiment with earthworms in connection with the application of organic fertilizers. The data indicate that soil of the heavily manured plot was more friable and more permeable to water. Also reported are: study on soil supersaturated with water in the vicinity of the Carpathians, and some characteristics of the water regime of soil in an area of excessive wetness. It is concluded that since soil moisture and water reserves of the soil are so variable soil hydrology problems are strictly of zonal character and cannot be evaluated on a unified basis. (Llaverias-USGS)
W69-00103

THERMAL-GRADIENT TRANSPORT OF WATER IN SANDY SOILS,
Academy of Sciences, USSR, V. V. Dokuchayev Institute of Soil Science.
N. F. Kulik.
Pochvovedeniye, No 11, pp 86-98, Nov 1967. 13 p, 9 tab, 3 fig, 11 ref. Soviet Soil Science, Transl by Scripta Technica, Inc, pp 1507-1519, Aug 1968.

Descriptors: *Water conveyance, *Sands, *Thermal radiation, Arid lands, Porosity, Translations.
Identifiers: *USSR, *Thermal diffusion, Temperature fluctuations, Soil hydrology.

In an investigation of the water regime of sandy terrain areas of southeastern European USSR, the thermal-gradient transport of water in soils (thermal diffusion) is briefly discussed. This study involved two phenomena of seasonal and daily soil temperature fluctuations resulting from changes in solar heat received by the earth. Experiments indicate that because of temperature gradients moisture moving in the aeration zone of sand and sandy soils can be utilized by plants. Most plant root systems are located within the zone of influence of the daily temperature fluctuations, where maximum values of water transport are observed. In an arid zone conditions in sand offer wide seasonal and daily temperature fluctuations, and favor utilization of soil moisture. When the temperature difference per cm of the profile is 1C,

the range of change in thermal-gradient water transport in sand and sandy soils is 0.0130 to 0.0150 mm/hr with moisture contents from twice the wilting percentage to the minimum moisture capacity. (Llaverias)
W69-00113

THE THEORY OF ABSORPTION IN AGGREGATED MEDIA,
CSIRO, Camberra City, Division of Plant Industry.
J. R. Philip.
Australian J Soil Res, Vol 6, No 1, pp 1-19, July 1968. 19 p, 5 fig, 4 tab, 23 ref.

Descriptors: *Absorption, *Porous media, *Aggregates, *Soil water movement, *Soil properties, Laplaces equation, Darcys Law, Porosity, Permeability.

The theory of absorption in unsaturated aggregated media is developed to provide a means of studying the applicability of diffusion analysis to transient flows. An aggregated medium is regarded as one made up of macroporosity, through which flow on the Darcy scale occurs, and microporosity, which is free to exchange water with the macroporosity. Absorption is analyzed with the aid of 2 extreme models of macropore flow, one a wet-front model and the other a linearized model. It is found that there is little difference between the solutions for the 2 models. The wet-front model is chosen for further study since it appears to be more realistic and is mor versatile. All models (and general physical considerations) indicate that the aggregated medium behaves initially as a classical medium with sorptivity equal to that of the macroporosity S, and the apparent sorptivity increases with time, ulimately approaching a limiting value greater than S. The cumulative uptake into the microporosity appears to be proportional to time initially, but is finally proportional to the sq root of time. It is concluded that diffusion analysis may usually be applied to aggregated media. Means of analyzing the exceptional cases, such as media containing large aggregates of low sorptivity, are also provided. (Knapp-USGS)
W69-00115

UNSTEADY SEEPAGE FLOW BETWEEN FULLY-PENETRATING TRENCHES,
Wisconsin Univ., Milwaukee, Dept. of Mech., and Northwestern Univ., Evanston, Ill., Dept. of Civil Eng.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00123

HYDROLOGIC PROPERTIES OF SEVERAL UPLAND FOREST HUMUS TYPES IN THE LAKE STATES REGION,
Michigan State Univ., East Lansing, Department of Forestry.
Wade L. Nutter, and Donald P. White.
Proj completion Rep, June, 1968. 147 p. 27 fig, 7 tab, 42 ref, 4 append.

Descriptors: *Humus, *Hydrologic properties, *Permeability, *Specific retention, *Evaporation, *Moisture tension, Organic soils, Porosity, Forest soils, Moisture content, Soil water movement.
Identifiers: Mulches.

Relatively undisturbed humus samples 16.5 cm in diameter and 25.4 cm deep were taken from 10 sites in forested Michigan regions and studied in the laboratory to determine the hydrological effect of humus on evaporation, infiltration, and water distribution, and to learn of the hydrology of humus formation. Humus types sampled are mull, duff-mull, mor, and a pseudo-duff mull. The mulls and duff-mulls held more water after drainage from saturation than the mors. The mors lost 80% by evaporation compared with 60% for the mulls and duff-mulls at high potential evaporation. Water moves rapidly through dry organic soils, wetting them only slightly. The suggestion that humus holds water for later infiltration does not seem to be valid, but if humus horizons become saturated during storms of long duration, they can hold water against overland flow because of their high porosity. Humus types cannot be classified by hydrologic properties alone, but their hydrologic properties parallel the present classification system and support the validity of the distinct types described in the Great Lakes Region. (Knapp-USGS)
W69-00128

EFFECT OF STRAW MULCH RATES ON SOIL WATER STORAGE DURING SUMMER FALLOW IN THE GREAT PLAINS,
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00144

WATER MOVEMENT IN DRY SOILS I. PHYSICAL FACTORS AFFECTING SORPTION OF WATER BY DRY SOIL,
Rothamsted Experimental Station, Harpenden, Herts., England.
D. A. Rose.
J of Soil Sci, Vol 19, No 1, pp 81-93, March 1968. 13 p, 9 fig, 4 tab.

Descriptors: *Soil water movement, Soil moisture, Arid lands, Atmosphere, Diffusivity, *Temperature, Salinity, Evaporation control, Environmental effects, *Sorption, Water vapor, Water transfer, Equations, Soil aggregates, *Moisture content, *Soil physics.

The paper considered effects of various soil physical conditions on uptake of water from a moist atmosphere by a soil sufficiently dry that both liquid and vapor components of flow may be important. Water extraction by growing plants will dry soil in the root zone to c pF 4.2 and natural evaporation can dry surface layers to c pF 6 or even drier in arid regions. Theoretical aspects of water movement in dry soils were explained using 5 equations. Sorption took place in soil columns that were in a turbulent atmosphere at constant temperature and realtive humidity. Diffusivity rose to a maximum and then fell as water content increased. Effects of environment and management were studied in the areas of temperature, pressure, porosity, organic manure, aggregate size, still atmosphere, mulching, salinity, evaporation suppressents, ignition and degradation of structure. In the dry soils tested, water movement was a mixture of liquid and vapor transfer and the relative importance of the two modes of flow varied from soil to soil. The data showed the effect of pre-treatment on diffusity and sorptivity but there was no experience yet to indicate what changes might have agricultural significance. (Blecker-Ariz)
W69-00148

CLIMATES OF SOME GREAT SOIL GROUPS OF THE WESTERN UNITED STATES,
California Univ., Berkeley.
Rodney J. Arkley.
Soil Sci, Vol 103, No 6, pp 389-400, June 1967. 12 p, 5 fig.

Descriptors: *Climatic zones, Arid climates, Weathering, *Soil types, Soil moisture, Soil formation, Soil temperature, Air temperature, Leaching, Plant growth, Evapotranspiration, Organic matter, Precipitation excess, Rainfall, *Reclamation states, *Water balance, Storage capacity.

This paper summarizes an investigation of the distribution of soils in the 11 western states in relation to climatic parameters taken from the water-balance analysis of 1082 climatic stations. The water-balance approach to climatic classification developed by Thornthwaite was used to relate climate directly to soil-forming processes. The method permitted an evaluation of the approximate moisture regime of soils throughout the year as well as the amount of water available for leaching and for plant growth. The leaching effectiveness of the climate, the actual evapotranspiration, and the mean annual temperature considered simultaneously served to represent climatic factors most closely related to the kind of 'zonal' soils one would expect to find under each climate. The results indicate that soils in arid climates were effected by evapotranspiration, accumulation and decomposition of organic matter, central 'core' climate, air and soil temperature, rainfall, leaching, excess of precipitation and soil moisture-storage capacity. (Blecker-Ariz)
W69-00149

THE WATER BUDGET OF IRRIGATED PASTURE LAND NEAR MURRAY BRIDGE, SOUTH AUSTRALIA,
Australia Dept. of Agriculture, Adelaide.
J. W. Holmes, and C. L. Watson.
Agr Meteorol, Vol 4, No 3, pp 177-188, May 1967. 12 p, 2 fig, 1 tab, 1 append.

Descriptors: Irrigation practices, Pastures, *Irrigation efficiency, Arid climates, Rainfall, Seepage, *Evaporation, Surface drainage, *Lysimeters, Radiation, *Hydrologic budget, Climatic data, *Equations.

The measurement of water efficiency on an irrigation district basis was often inaccurate because of inadequate control of factors that occur in arid climates. The purpose of the experiment was to measure components of the water balance which included rainfall, amount of irrigation, evaporation, surface and underground drainage. Techniques of measurement yielded a standard error of about 10% of the total water inventory. The evaporation, measured with the help of small lysimeters, was strongly correlated with measured net radiation. Three formulae for estimating evaporation, based on large weighable lysimeters, were tried. By suitable choice of the coefficient for introducing the effect of the drying power of the air into the formula, it was possible to obtain a close estimate of evaporation. The correlation was no better than the correlation between evaporation and net radiation. (Blecker-Ariz)
W69-00150

INFILTRATION IN SANDS AND ITS RELATION TO GROUNDWATER RECHARGE,
U. S. Geological Survey, Washington, D. C.
W. O. Smith.
Water Resources Res, Vol 3, No 2, pp 539-555, 1967. 17 p, 8 fig.

Descriptors: *Infiltration, Capillary conductivity, Hydraulic conductivity, Soil moisture, *Sands, *Groundwater recharge, Arid climates, Topography, Field capacity, *Sediments, Equations, Retention, Rocks.

Sediments consisting of boulders, gravel, sand and silt are, in addition to fissured rocks, the principle rocks capable of infiltration adequate for substantial groundwater recharge in arid climates. The problem considered in the study was infiltration into sands as related to groundwater recharge. The principles of capillarity applicable to infiltration process were reviewed. Qualitative experiments were described to show the nature of the hydraulic transfer process in sands. The problem of how deeply a given rain will penetrate into a sand, and under what conditions it will contribute to the recharge of groundwater, are considered. Influence of topography on groundwater recharge and the nature of specific retention or field capacity in sands were discussed. The infiltration process in dry sand consisted essentially of the downward passage of bulk water. Infiltration in sands was a simple hydraulic process subject only to modification by capillarity arising from the internal pore structure of the sand. The amount of water extracted from the infiltrating mass by a dry sand was determined by the specific retention of the sand. (Blecker-Ariz)
W69-00160

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IN SITU MEASUREMENT OF SOIL SALINITY WITH A SENSOR,
U. S. Salinity Lab., Riverside, Calif.
J. D. Oster, and R. D. Ingvalson.
Soil Science Soc Proc, Vol 31, No 4, pp 572-574, July-August 1967. 3 p, 2 fig, 1 tab.

Descriptors: *Saline soils, *Electrical conductance, *Temperature, Plant physiology, Soil profiles, Soil water movement, Irrigation effects, Moisture uptake, *Measurement, Soil-water-plant relationships, Electrodes.
Identifiers: *Thermistors, *Sensors.

Electrical conductivity (EC) of the soil solution was measured in situ with a salinity sensor whose salt-sensitive element was a ceramic electrical conductivity cell. The face electrode was covered with a thin layer of ceramic, thereby preventing dislodgment of the electrode and improving the stability of the sensor. The temperature correction used values from tables corresponding to the temperature as measured by the thermistor. The sensors measured changes in EC during an irrigation cycle due to water uptake by the plant and salt movement in the soil profile by convection of salt in the soil water. The accuracy of the measurement was estimated at plus or minus 0.5 mmho/cm. (Blecker-Ariz)
W69-00163

THE QUALITY OF WATERS PERCOLATING THROUGH STRATIFIED SUBSTRATA, AS PREDICTED BY COMPUTER ANALYSES,
California Univ., Water Resources Center, Davis.
K. K. Tanji, L. D. Doneen, and J. L. Paul.
Hilgardia, Vol 38, No 9, pp 319-347, June 1967. 29 p, 17 fig, 5 tab, 6 append.

Descriptors: *Water quality, *Computer programs, *Soil profiles, *Soil chemical properties, Arid climates, Saturated soils, Percolating water, Gypsum, Cation exchange, Stratfied flow, Equations, *Saturation, Analytical techniques, Stratification, Solutes.

This paper presented theoretical consideration and procedures utilized in Fortran computer programs and resulting predictions on quality of waters percolating through three substrata profiles in the arid San Joaquin Valley of California. A study was done on prediction of chemical changes induced by saturating a stratfied substrata profile, prediction of quality of the percolating water and changes in chemical properties of the profile. Comprehensive predictions on solute concentrations in the percolate and chemical changes in the substrata profile were presented. Formulations in the computer programs were based on theoretical considerations concerning solubility and dissociation of gypsum and cation exchange. (Blecker-Ariz)
W69-00164

COMPUTER SYSTEM FOR THE REDUCTION AND ANALYSIS OF SOIL MOISTURE DATA,
Virginia Polytechnic Institute, Blacksburg.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-00232

PERMEABILITY CALCULATED FROM DESATURATION DATA,
Canada Dep. of Agr., Lethbridge, Alberta, and Oregon State Univ., Corvallis, and Colo. State Univ., Fort Collins.
Garland E. Laliberte, Royal H. Brooks, and Arthur T. Corey.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR1, Pap 5843, pp 57-71, Mar 1968. 15 p, 3 fig, 3 tab, 23 ref, 2 append.

Descriptors: *Permeability, *Porous media, *Soils, *Pore pressure, Drainage, Model studies, Equations, Soil compaction, Saturation, Regression analysis.
Identifiers: Capillary pressure-permeability relationships, Porosity-permeability relationships, Kozeny equations.

An equation is presented for calculating saturated permeability from capillary pressure-desaturation data. The use of this equation along with the relative permeability equations of Brooks and Corey is proposed for calculating the permeability of both saturated and partially saturated media. The analysis leading to the development of the equation is based on theory developed in the petroleum industry. The equation utilizes parameters introduced by Brooks and Corey for describing the hydraulic behavior of partially saturated porous media on the drainage cycle. In laboratory measurements, the permeability of three disturbed soils each packed at 5 different values of porosity was determined at various capillary pressures. Predicted relationships were calculated using capillary pressure-desaturation data in the new equation and in the relative permeability equations of Brooks and Corey. Calculated and experimental values of permeability agreed within 27% over the range of capillary pressures studied. (Knapp-USGS)
W69-00236

CONTROLS ON Mn, Fe, Co, Ni, Cu, AND Zn CONCENTRATIONS IN SOILS AND WATER: THE SIGNIFICANT ROLE OF HYDROUS Mn AND Fe OXIDES,
U. S. Geological Survey, Denver, Colorado.
For primary bibliographic entry see Field 02K.
For abstract, see .
W69-00259

A SOIL MOISTURE REGIME AND MICROCLIMATOLOGICAL STUDY OVER SAND DUNES IN WESTERN RAJASTHAN,
Central Arid Zone Research Inst., Jodhpur, Rajasthan, India.
A. Krishnan, P. N. Bhatt, and P. Rakhecha.
Ann of Arid Zone, Vol 5, No 1, pp 1-9, March 1966. 9 p, 4 fig, 3 tab.

Descriptors: *Sands, Dunes, *Soil moisture, Climatic data, Ecology, Soil temperature, Air temperature, Humidity, *Microclimatology, Monsoons, Arid lands, Vegetation establishment.
Identifiers: *India.

In order to study the microclimate and soil moisture regime of the dunes of Rajasthan, stabilized and unstabilized dunes at Osian were selected. Diurnal cycle, microclimate and soil moisture observations were taken on two days during the four seasons: winter, hot weather period, monsoon and post monsoon. High moisture concentration occurred below 4 meter depth in the stabilized sand dune during March to July and below 1.5 meter depth in the unstabilized sand dune throughout the year. Vertical moisture movement under the influence of temperature gradients appeared to be the factor causing this occurrence. (Affleck-Ariz)
W69-00365

INFLUENCE OF SOIL TEXTURE AND RAINFALL ON THE RESPONSE OF COTTON TO MOISTURE REGIME,
Lower Rio Grande Valley Research and Extension Center, U. S. Dept. of Agriculture, Weslaco, Texas.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00374

WATER ENTRY, WATER USE AND SEASONAL-MOISTURE REGIMES IN FLOOD-IRRIGATED RIVERINA SOILS,
Australia CSIRO, Div. of Soils.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00382

2H. Lakes

ON THE INFLUENCE OF THE POLDERING OF LAKE TOGO-IKE FOR THE TOGO HOT SPRING GROUP,
Japanese Society of Limnology, Otsu, Japan.
Kinzo Seno, Soki Yamamoto, and Shirobe Kiuchi.
Jap J of Limnol, Vol 29, No 1, pp 1-12, May 1968. 12 p, 7 fig, 6 tab.

Descriptors: *Surface-groundwater relationships, *Hot springs, *Water temperature, *Discharge (Water), Water-level fluctuations, Chlorides, Sulfate, Tidal effects, Water quality.
Identifiers: Poldering, Lake Togo-ike, Japan.

The influence of change in lake level on the discharge of hot springs at Lake Togo-ike, a brackish lake situated in the middle of Tottori Prefecture, was studied. All of the springs of the Togo hot spring group have the same chemical constituents and ground temperature, suggesting that they have a common origin. Some of these springs discharge through the lake bottom, but they have little influence on quality of the lake water. Factors which will affect spring discharge are barometric pressure, rainfall lake-level change, tides, and pumping. Barometric and tidal effects are not separated. The effect of lake-level changes on the spring discharge, which is larger at Azusa than at Togo, suggests that change of lake level directly affects the discharge of hot springs. It is concluded that deepening of this lake will cause a decrease of hot springs discharge. (Knapp-USGS)
W69-00132

LIMNOLOGICAL STUDIES OF A RESERVOIR, LAKE YUBARA-KO, OKAYAMA PREFECTURE,
Japanese Society of Limnology, Otsu, Japan.
Masami Higuti.
Jap J of Limnol, Vol 29, No 1, pp 13-20, May 1968. 8 p, 3 fig, 1 tab, 2 ref.

Descriptors: *Limnology, *Eutrophication, *Reservoirs, *Plankton, *Water quality, Dissolved oxygen, Hydrogen ion concentration, Amonia, Color, Turbidity, Opacity, Zooplankton.
Identifiers: Yubara-Ko Lake, Japan.

The limnological features of Yubara-ko, a man-made lake in the northern part of Okayama Prefecture, which stores water for hydroelectric power, were investigated on August 7-10, 1965, 10 yr after the water was impounded. The metalimnion developed between 15-16m and 23m. The color of water is Forel's Nos. 6-9, the Secchi's disc transparency varies from 1.5 to 4.0m. The pH-values range from 7.2 to 7.4 in the surface and from 6.0 to 7.3 in the bottom water. The contents of dissolved oxygen vary between 7.88-10.56 ppm in the surface and 8.67-10.4 ppm in the bottom water. Total Fe is 0.004-0.48 ppm in the bottom water. The amount of ammonium is 0.08 ppm, four times as much as that in 1958. Nutrients in the water have become richer in the past 10 yr. Of 30 species of plankton found, 11 are phytoplankton and 19 zooplankton. The plankton concentration ranged from 5,370 per 10 liters to 121 per 10 liters. (Knapp-USGS)
W69-00134

FORECASTING THE LEVELS OF THE GREAT LAKES,
U. S. Lake Survey, Detroit, Michigan.
B. G. Decooke, and E. Megerian.
Water Resources Research, Vol 3, No 2, pp 397-403, Second Quarter 1967. 7 p, 4 tab, 5 ref, 1 append.

Descriptors: *Forecasting, *Great Lakes, Water levels, Temperature, Precipitation, Time series analysis.
Identifiers: *Net Basin Supply, Multiple linear regressions, Current trend.

A description is given of the U. S. Lake Survey method of forecasting Great Lakes water levels. The method, in general, consists of determining a level for each month of a 6-month forecast period on each of the Great Lakes by routing a predicted volume of water (Net Basin Supply) to each of the Great Lakes basins. The technique employed in prediction of the volume of the water consists of using multiple linear regressions based upon U. S.

Weather Bureau precipitation and temperature data as predictors for the first month and trend predictors for the second through the sixth month. This technique results in forecasting of lake levels on the average from 15 to 40% closer to the recorded lake levels, in comparison with the technique that utilizes the long-term average volume of water as the basis of projection. (Seneca-Rutgers)
W69-00202

THE HIDDEN FLORA OF A LAKE,
Hebrew University of Jerusalem.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00360

THE LIMNOLOGICAL BEHAVIOR OF IRON IN NATURAL WATER,
Illinois State Water Survey, Peoria, Water Quality Sect.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00388

2I. Water in Plants

EFFECTS OF MOISTURE STRESS ON GERMINATION OF ALKALI SACATON, GALLETA AND BLUE GRAMA,
U. S. Forest Serv., Rocky Mountain Forest and Range Experiment Station, Albuquerque.
O. D. Knipe.
J Range Manage, Vol 21, No 1, pp 3-4, January 1968. 2 p, 1 fig, 2 tab.

Descriptors: *Grasses, *Moisture tension, *Seeds, Germination, *Moisture stress, Aqueous solutions.

The objective of the study was to determine the effect of moisture stress and seed germination. Seeds were collected within the arid Rio Puerco watershed near the village of San Luis, 58 miles northwest of Albuquerque, New Mexico. Each species was replicated four times at moisture tension levels of 0, 1, 4, 7, 10, 13, and 16 atm. Alkali sacaton was affected most by increases in moisture tension. Percent germination of alkali sacaton was significantly reduced by 1 atm moisture tension, and was further reduced by each 3 atm increase with the exception of 13 to 16 atm. Present germination of galleta and blue grama was not significantly reduced until a moisture tension of 10 atm was reached. The rapidity of germination of galleta and blue grama was delayed by moisture tension of 4 atm and the rapidity of germination of alkali sacaton was delayed by a moisture tension of 1 atm. (Blecker-Ariz)
W69-00151

WATER USE IN LARGE SCALE IRRIGATION SCHEMES,
Irrigation Research Lab., Griffith, New South Wales, Australia.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00155

EFFECT OF TEMPERATURE ON NET ASSIMILATION RATE,
GSIRO, Canberra, Australia, Division of Plant Industry.
J. Warren Wilson.
Ann of Botany, N S, Vol 30, No 120, pp 753-761, 1966. 11 p, 2 fig, 1 tab, 23 ref.

Descriptors: *Temperature, Leaves, Arid climates, Sorghum, *Growth rates, Plant physiology, Regression analysis, *Plant growth.
Identifiers: *Assimilation rate, Dry matter, Rape, Sunflower.

The net assimilation rates (rate of increase of dry matter per unit leaf area) and other growth attributes were compared for rape, sunflower and maize plants growing at temperatures of 10, 16, 22, 28 and 34 deg C. These plants were grown in arid climates. Plants were widely spaced to reduce the mutual shading effect and grown under 3,000 f c fluorescent lighting to simulate summer weather. The estimates of the net assimilation rate (EA) suggested that the optimum temperature was lowest in rape (just over 20 deg C) and highest in maize (just below 30 deg C). Relative growth-rate (RW) was almost identical with relative leaf-area growth-rate (RA) at each temperature for rape and sunflower and both RW and RA rose more steeply than EA with increasing temperature. In hot climates EA fell with an increase in temperature in those species which had low optima. In warm conditions the EA rate varied little with temperature by only plus or minus 10% between 12 and 30 deg C for rape and 23 and 36 deg C for maize. (Blecker-Ariz)
W69-00158

THE COMPOSITION OF SEVERAL ARID SPINIFEX GRASSLANDS OF CENTRAL AUSTRALIA IN RELATION TO RAINFALL, SOIL WATER RELATIONS, AND NUTRIENTS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research.
R. E. Winkworth.
Australia J of Botany, Vol 15, No 1, pp 107-130, 1967. 24 p,3 fig, 3 plate, 13 tab, 18 ref.

Descriptors: *Grasslands, Arid climates, Biological communities, Climatic data, Soil-water-plant relationships, *Rainfall, *Temperature, Humidity, Evaporation, Geomorphology, Soil physical properties, Soil chemical properties, Plant physiology, *Soil profiles, *Vegetation, Sands, Clays, Vegetation regrowth, Environmental effects.

The paper reports the community analysis and associated climatic and soil studies of arid spinifex grasslands in five locations in the Northern Territory. All sand-plains were flat to broadly undulating. A study of the arid climate included rainfall, temperature, relative humidity and tank evaporation. Soils were studied with respect to morphology, physical and chemical properties and plant nutrition. The outstanding feature of the soils was their sandy nature, the profiles having large proportions of sand and low clay contents down to the underlying substrates. The vegetation study included a general description of where the plants were found, their floristic differences and quantitative community characteristics. Uniformity of the sand-plain vegetation of central Australia overrode minor geographical differences. The main climatic feature was the increase in rainfall from 5 in. annually to 14 in. from south to north. Communities regenerating from fire were very extensive (about 4000 sq. miles). The almost exclusive occupancy of the sand-plains by spinifex suggested true adaption to this soil environment. (Blecker-Ariz)
W69-00162

COMPETITION BETWEEN BURROWEED AND ANNUAL AND PERENNIAL GRASSES FOR SOIL MOISTURE,
U. S. Forest Serv., Rocky Mountain Forest and Range Experiment Station, Tucson.
Dwight R. Cable.
Proc Amer Forage and Grassland Counc, pp 11-27, 1966. 17 p, 8 fig.

Descriptors: *Grasses, Plant groupings, Semiarid climates, Vegetation, Root development, Root distribution, *Root systems, Environmental effects, Summer, *Competition, Ecology, *Soil moisture, Annual, Growth states, *Plant growth, Phenology, Water requirements.
Identifiers: *Perennial, *Burroweed.

A study was conducted to determine the extent of competition for soil moisture between annual grass, perennial grass and burroweed and the influence of rooting habits and growth cycles on these competitive relations. The study was conducted on the Santa Rita Experimental Range, south of Tucson, Arizona, in a semidesert grass-shrub type area. The areas studied were herbage production, plant root systems, phenological development and moisture extraction patterns under different types of vegetation cover. Perennial grass production was reduced about 20% on plots with annual grass or burroweed competition and about 44% on plots with both. Because burroweed has a taproot system with little lateral spread and is primarily a spring grower, summer yields of annual and perennial grasses are only moderately affected by the presence of burroweed. Perennial grass, because of its deeper and perennial rooting habit, competed strongly with annual grasses during the summer growing season. (Blecker-Ariz)
W69-00167

WATER STRESS IN NATIVE VEGETATION DURING THE DROUGHT OF 1965,
Australia Commonwealth Sci. Indus. Research Org., Canberra.
E. W. Pook, A. B. Costin, and C. W. E. Moore.
Aust J Bot, Vol 14, No 2, pp 257-267, July 1966. 11 p, 4 tab, 3 plate.

Descriptors: *Moisture stress, Vegetation, *Droughts, Fine-textured soils, Trees, Soil moisture, *Moisture content, *Biological communities, Rainfall, Soil profiles, Crop response, Wilting, *Soil-water-plant relationships, Leaves.

Reported in this paper is the reaction of native vegetation in parts of the Australian Capital Territory and Monaro Region where drought occurred in 1965. The general pattern was for wilting to occur in lightertextured, stonier, or shallower soils, especially on steep and sunny aspects. Variation between the species of Eucalyptus was largely a reflection of site differences. Trees of all size classes showed signs of water stress. Relative moisture content of the foliage of E rossii on E macrorhyncha could be low before signs of water stress were obvious. Comparison of moisture contents of whole trees showing different degrees of water stress indicated that the prolonged period of dehydration had caused general drying out of the trees, rather than only leaf and twig desiccation. The differences in soil moisture storage were chiefly a function of soil volume, as determined by profile depth and proportion of fine soil particles. It was suggested that the so-called ineffective summer rain in south-eastern Australia was both effective and essential for native communities on soils of low water-holding capacity. The role of drought in distribution of native communities was discussed. (Blecker-Ariz)
W69-00168

ARIDITY AND SEMI-ARIDITY, A PHYTO-CLIMATIC CONSIDERATION WITH REFERENCE TO INDIA,
Institut Francais, Pondichery, India.
For primary bibliographic entry see Field 06G.
For abstract, see .
W69-00369

GERMINATION STUDIES OF PENNISETUM TYPHOIDES SEEDS TREATED WITH SUCCINIC ACID UNDER DIFFERENT WATER POTENTIALS,
Central Arid Zone Research Inst., Jodhpur, Rajasthan, India.
Man Singh Manohar, and M. K. Mathur.
Ann of Arid Zone, Vol 4, No 2, pp 147-151, Sept 1965. 5 p, 1 fig, 2 tab.

Descriptors: *Germination, Seeds, Arid lands, *Growth rates, Osmosis, Plant growth.
Identifiers: *Water potential, Succinic acid.

The influence of low water potentials on germination of Pennisetum typhoides when treated with succinic acid was studied in India. Seeds were treated with four levels of succinic acid for 0, 3 and 6 hours. These seeds were then sown in 0, -500, -

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1000 and -1500 joules/kg potential solutions. It was found varied levels of succinic acid had little effect upon total germination; however a marked effect was observed with varying osmosis potentials. Rate of germination as well as total germination were reduced in lower osmosis potentials. (Affleck-Ariz)
W69-00370

2J. Erosion and Sedimentation

SEDIMENTARY AND FAUNAL FACIES ASSOCIATED WITH THE DRAINING OF CROPSTON RESERVOIR,
Nottingham Univ., Department of Geology, Great Britain.
W. A. Cummins, and A. J. Rundle.
The Mercian Geologist, Vol 2, No 4, pp 389-400, Aug 1968. 10 p, 2 fig, 1 tab, 2 plate, 3 ref.

Descriptors: *Reservoirs, *Drainage effects, *Erosion, *Biological communities, *Sedimentation, Aquatic environment.
Identifiers: *Reservoir drainage, *Leicester, Great Britain, Faunal assemblages.

The sedimentary and faunal changes resulting from the draining of Cropston Reservoir in Charnwood Forest, which supplied water to Leicester, England, were studied. The reservoir had been in continuous use for 95 years. The slow uniform deposition of black mud was interrupted and a new pattern of erosion, sedimentation and desiccation destroyed the molluscan fauna. Shoreline reed flora continued to flourish. Bottom muds were eroded and redeposited nearer the dam. Remains of the molluscan fauna were sampled and listed. The features produced by draining the reservoir are studied in terms of their preservation in the geological record when the reservoir is refilled and black mud sedimentation is resumed. Observation of a geological process taking place should help in the interpretation of the past geological record. (Knapp-USGS)
W69-00090

URBANIZATION'S EFFECT ON SEDIMENT YIELD IN NEW JERSEY,
U S Geological Survey.
Peter W. Anderson, and John E. McCall.
J Soil and Water Conserv, Vol 23, No 4, pp 142-144, July-Aug 1968. 3 p, 5 fig, 2 ref.

Descriptors: *Sediment yield, *Urbanization, Streams, Runoff, Storm runoff, New Jersey, Delaware River, Water pollution.
Identifiers: Philadelphia, Trenton, New York City.

Data on sediment content of New Jersey streams are summarized; they suggest that yields are proportional to the degree of urbanization. The sparsely populated Pine Barrens yield 10-40 tons per sq mi per yr. The moderately heavily urbanized Delaware River area yields 25-100 tons generally, and up to 500 tons near Philadelphia. The northwestern area of New Jersey is hilly with steep slopes and rapid runoff, but a low degree of urbanization; its sediment yields are 25-100 tons per sq mi per yr, while yields in the Trenton-New York City area, which is very heavily urbanized and probably has about the same topography and natural sediment yield as the northwestern area, are several thousand tons. Bacteria and organic content of water are also much higher in urban streams. In the Delaware River near Trenton, 5-25% of the suspended load is oxidizable. The U S Geological Survey is studying the effects of urbanization on sediment in the Stony Brook Basin, about 48 sq mi in area, 10 mi north of Trenton. The amount of sediment for a given rate of runoff has increased significantly with urbanization of the area from 1956 to 1958. (Knapp-USGS)
W69-00118

SEDIMENTATION IN THE NATION'S RESERVOIRS,
Department of Agriculture, Oxford, Mississippi, Sedimentation Laboratory.
Farris E. Dendy.
J Soil and Water Conserv, Vol 23, No 4, pp 135-137, July-Aug 1968. 3 p, 5 fig, 1 tab, 15 ref.

Descriptors: *Reservoir silting, Sediment yield, Reservoir storage, Trap efficiency.
Identifiers: Reservoir storage depletion.

Reservoir sedimentation data compiled by the U S Department of Agriculture Sedimentation Laboratory are summarized. The Nation's 968 reservoirs range from small ponds to over 1 million acre-ft. Annual average storage loss was 150,000 acre-ft, about 0.2% of initial total capacity, well within the design requirments of most reservoirs. Average depletion rates are much higher in reservoirs of 100 acre-ft or less, which account for only a small part of total reservoir capacity, but are 40% of the total number of reservoirs. Depletion was less than 1% for 58% of the reservoirs larger than 100,000 acre-ft, over 3% for 15% of the reservoirs, and in excess of 10% for only 2% of the reservoirs. Average sediment accumulation rates, in general, decrease as drainage area increases. Prediction of depletion rates can be successful only if local empirically determined relationships are used. The conclusions reached are that the depletion rate of 0.2% is not alarming, the 3% rate in small upland and reservoirs seems excessive, and if present rates continue, about 20% of small reservoirs will be half filled with silt in 30 years. (Knapp-USGS)
W69-00119

DILUTION METHODS OF MEASURING TRANSPORT OF SAND FROM A POINT SOURCE,
Hydraulics Research Station, Wallingford, Berkshire, England.
G. H. Lean, and M. J. Crickmore.
J of Geophys Res, Vol 71, No 24, pp 5843-5855, December 1966. 13 p, 12 fig, 4 tab.

Descriptors: Transportation, *Sands, Channels, Measurement, Particle size, *Velocity, Elevation, Dye releases, *Tracers, Flow, Dispersion, *Diffusion, *Equations, Steady flow, Sediment transport, Mixing, Streams.
Identifiers: *Point source, *Transport.

The object of the investigation was to compare lateral dispersion of sand and water in the absence of a lateral velocity gradient and to examine the validity of the point source tracer method for measurement of sand transport. Distribution of labeled particles from a steady point source and mean velocity and vertical diffusion coefficient were discussed using equations. The experiments demonstrated that in steady flow constant-dilution and time integration methods could be applied to measurement of sand transport by injection at a point source, provided that sediment transport was uniform across the width of the channel and a sufficient distance (20 feet in the case studied) was allowed between the point and measuring section for mixing. Independence of tracer concentration in elevation allows the method to be applied to samples taken in the suspended flow. Tracer concentrations measured both on the bed and in the water resulted in transport values accurate to within 5% for positions beyond the mixing distance. The methods described could be used to study transport of sand in streams and rivers in arid areas. (Blecker-Ariz)
W69-00145

PROCESSES ON ARID-REGION ALLUVIAL FANS,
Minnesota Univ., Dept. of Geology and Geophysics.
Roger LeB Hooke.
J of Geology, Vol 75, No 4, pp 438-460, July 1967. 23 p, 10 fig, 5 tab, 23 ref, 1 append.

Descriptors: *Alluvial channels, *Channel morphology, Slopes, Petrography, Infiltration, Weathering, *Arid lands, Sediment discharge, Sediment transport, Alluvium, Geomorphology, Deposition (Sediments), Model studies, Mudflows, Sands.
Identifiers: *Fans.

The object of the study was to understand processes acting on fans and features produced by these processes. Three fans were studied in the desert region of California. Reconnaissance work included qualitative observations of features such as debris size, lithology, channel form, fan area and slope. The laboratory study included fan morphology, qualitative relationships among fan slope, water discharge, debris-flow behavior and depth of fanhead incision. The fans had six distinguishable ages of alluvium and segmented profiles which may have resulted from tectonic disturbance of the fan-source system. Small alluvial fans were built of mud and sand in a laboratory apparatus. These fans were not intended to be scale models of a natural fan but were treated as small fans in their own right. Justification for use of laboratory models was given. General equivalence of slopes on laboratory and natural fans indicated that gross scaling relationships between debris size and discharge were similar. Areas of debris flows, fluvial processes, mechanics of sediment transport, fan morphology, water flows, infiltration and sieve deposition, channels and deposition on alluvial fans and fanhead incision were discussed. (Blecker-Ariz)
W69-00165

A MONOGRAPH ON SEDIMENT TRANSPORT IN ALLUVIAL STREAMS,
Denmark Technical Univ., Copenhagen.
Frank Engelund, and Eggert Hansen.
Monogr, Denmark Tech Univ, Hydraul Lab, 62 p, 1967. 30 fig, 3 tab, 31 ref.

Descriptors: *Sediment transport, *Alluvial channels, *Streams, *Channel flow, *Stage-discharge relations, Water conveyance, Hydraulics.
Identifiers: Channel design, Monograph.

Transport of sediments in alluvial streams is explained in a generally non-mathematical or 'engineering' sense, and the basic mechanism of sediment transport is reviewed in a short text taken from lectures given at the University of Denmark. Part of the book is based on research in the Hydraulic Laboratory in Copenhagen and has not previously been presented except in discussions or progress reports. The topics covered are sediment properties, hydraulics of alluvial streams, the similarity principle, fluviology, and numerical examples of prediction of stage-discharge relations and design of channels. (Knapp-USGS)
W69-00238

2K. Chemical Processes

GEOCHEMISTRY OF GROUNDWATER FROM UPPER CRETACEOUS-LOWER TERTIARY SAND AQUIFERS IN SOUTH-WESTERN VICTORIA, AUSTRALIA,
Geological Survey, Melbourne, Australia, Mines Department.
M. W. Johns.
J Hydrol, Vol 6, No 4, pp 337-357, Aug 1968. 21 p, 4 fig, 2 tab, 22 ref.

Descriptors: *Water chemistry, *Groundwater, Groundwater basin, Saline water, Sodium, Chlorides, Ion exchange, Magnesium, Sulfates, Carbonates.
Identifiers: *Geochemical processes, Otway Basin, Victoria, Australia.

The groundwater chemistry of the sand aquifers in the upper Cretaceous and Lower Teriary of the Otway Basin, SW Victoria, Australia was studied by considering separately the main geochemical processes that produce variations in water composition. The processes are cation exchanges in-

volved in formation of sodium bicarbonate, release of carbonic acid with variations in alkalinity, incorporation of originally oceanic saline water, and variations of sulfate-chloride ratio by sulfate accumulation or bacterial action. The waters have been divided into several classes. Class A has Na:Cl less than 80, class B has Na:Cl between 80 and 95, class C has Na:Cl over 95 and Mg:Cl over 20, and class D has Na:Cl over 95 and Mg:Cl less than 20. Class B, C, and D waters are found elsewhere in Australia, but class A water is found only in the Otway Basin. (Knapp-USGS)
W69-00122

INTERACTION BETWEEN ALUMINUM AND PHOSPHATE IN AQUEOUS SOLUTION,
Rutgers Univ., New Brunswick, New Jersey.
Pa Ho Hsu.
Advances in Chem Ser, No 73, pp 115-127, 1968. 13 p, 3 fig, 2 tab, 17 ref.

Descriptors: *Phosphate, *Aluminum, *Inorganic compounds, *Water chemistry.
Identifiers: Complex ions, Polymers.

Hydroxy-aluminum solutions with NaOH/Al molar ratios from 0 to 2.7 were mixed with a sodium phosphate solution to give a phosphate/Al ratio from 0 to 15, and it was found that hydroxy-aluminum polymers and Al ion did not yield the same reaction products with phosphate. The complete precipitation of hydroxy-aluminum polymers by phosphate at their isoelectric points was interpreted to be a simple 'neutralization' of the net positive charge of the polymer by the phosphate anion. Aluminum formed soluble complexes with phosphate up to a phosphate/Al molar ratio of 8. In solution with polymers and Al ions, each reacted with phosphate separately because there is no rapid equilibrium between Al ion and polymers. (Knapp-USGS)
W69-00257

CONTROLS ON Mn, Fe, Co, Ni, Cu, AND Zn CONCENTRATIONS IN SOILS AND WATER: THE SIGNIFICANT ROLE OF HYDROUS Mn AND Fe OXIDES,
U. S. Geological Survey, Denver, Colorado.
E. A. Jenne.
Advances in Chem Ser, No 73, pp 337-387, 1968. 51 p, 6 fig, 1 tab, 257 ref.

Descriptors: *Trace elements, *Soil chemical properties, *Oxides, *Water chemistry, *Sorption, Chelation, Organic matter, Carbonates, Clays.
Identifiers: Hydrous oxides, Complex ions.

It is proposed that the hydrous oxides of Mn and Fe, in general, furnish the principal control on the fixation of Co, Ni, Cu, and Zn (heavy metals) in soils and fresh water sediments; hydrous oxides of Mn and Fe are nearly ubiquitous in clays, soils, and sediments. The common occurrence of these oxides as coating, allows the oxides to exert chemical activity far out of proportion to their total concentrations. Sorption or desorption of these heavy metals occurs in response to the following factors: (1) aqueous concentration of the metal in question; (2) aqueous concentration of other heavy metals; (3) pH; and (4) amount and strength of organic chelates and inorganic complex ion formers present in solution. Other suggested controls on the concentration of the heavy metals in soils and fresh waters are: (1) organic matter; (2) clays; (3) carbonates; and (4) precipitation as the discrete oxide or hydroxide. The available information on these controls is reviewed and found to be inadequate to explain the fixation of Co, Ni, Cu, and Zn. (Author)
W69-00259

EFFECT OF RECLAMATION SYSTEM AND CULTIVATION ON THE DISTRIBUTION OF SALINITY AND ALKALINITY IN SOIL PROFILES IN AN AREA IN NORTHERN PART OF THE NILE DELTA,
Cairo Univ., Cairo, Egypt, Soils Dept.

For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00376

THE RELATION OF HUMIC COLOR TO IRON IN NATURAL WATERS,
Minnesota Univ., Minneapolis, Limnological Research Center.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-00385

2L. Estuaries

SALT-WATER ENCROACHMENT IN THE SOUTH EDISTO RIVER ESTUARY, SOUTH CAROLINA,
U. S. Geological Survey, Water Resources Division, Washington, D. C.
T. Ray Cummings.
U S Geol Surv Water-Supply Pap 1586-I, 1968. 19 p, 12 fig, 2 tab, 11 ref.

Descriptors: *Encroachment, *Estuaries, *South Carolina, Tidal effects, Discharge (Water), Saline water intrusion, Water quality, Winds, Dissolved solids.
Identifiers: *South Edisto River, *Specific conductance.

A study of salt-water encroachment in the South Edisto River, South Carolina, found that chemical characteristics are altered to about 25 mi upstream from the mouth. Precise correlations of discharge, tide, and weather, the factors affecting distance of the salt-water encroachment, with specific chemical characteristics are not possible in the report area. Mean discharge, flow duration, high tide frequency, relation of specific conductance to discharge, frequency curves of specific conductance, relation of dissolved solids to conductance, frequency curves for dissolved solids and chlorides, and water temperatures, are presented graphically. Tables show maximum and minimum values of dissolved solids and the physical properties of water at 2 gaging stations. (Knapp-USGS)
W69-00104

DELAWARE COAST, BEACH EROSION CONTROL AND HURRICANE PROTECTION.
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, Senate Doc No 90, 110 p, 1968. 21 photo, 20 tab, 1 append, 1 suppl.

Descriptors: *Beach erosion, *Shore protection, *Flood control, *Landfills, *Coastal engineering, Hurricane, Delaware.
Identifiers: Delaware, Atlantic coastal area.

A beach erosion and hurricane protection study of beaches along the Delaware Coast found that all the public and private beaches have been damaged by erosion, and that improvements landward of the beaches are threatened. The quantity of sand supplied naturally to the beaches by littoral drift is insufficient to offset the loss from storms and high tides. Plans of improvement for individual localities, financed as small beach erosion control projects, consisting of initial placement of fill, periodic nourishment of beaches, construction of groins where required, and maintenance and replacement of existing structures, are economically justified only for Broadkill Beach, South Bowers, and Lewes. Beach erosion control for the entire Delaware Coast financed as a whole, consisting of fill, bulkheads, nourishment, placement of sand fences, and planting of dune grass is, however, economically justified by the benefits in prospect. The estimated first cost is $8,044,000, annual cost is $157,700, and the benefit-cost ratio is 1.4 for the northern reach and 1.6 for the southern reach. (Knapp-USGS)
W69-00114

MIXING OF THE CONGO RIVER WATERS WITH THE WATERS OF THE SOUTH ATLANTIC,
Institut geographique du Congo.
Jean Meulenbergh.
Academie Royale des Sciences d'Outre-Mer, Classe des Sciences Techniques, NS, 16-6, Brussels, 1968. 148 p, 55 fig, 4 tab, 28 ref. Trans by USGS.

Descriptors: *Estuarine environment, *Watersheds (Basins), *Aquatic environment, Fish migration, Tidal effects, Water temperature, Fish attractants.
Identifiers: *Water mixing, *Congo River, Africa, Oceanography.

As a contribution to knowledge of the fluviomarine zone of the Congo River, an analysis is presented based on hydrological data collected by electronic sounding and other equipment between 1959 and 1963. The fluviomarine water quality varies with changing river discharge (between 25,000-60,000 cu m/sec) and the nature of the marine water. Effects of tides, coastal currents, and wind action are discussed. Temperature and salinity observations are graphed. Contrary to general belief, the study shows that in this zone there is turbulent mixing of fresh and sea waters of different salinity and temperature. At about 20 m depth, river waters mix with cold salt waters of the submarine canyon. T-S diagrams indicate that at certain seasons, normal salinity occurs at depths between 20-25 m. The data are considered of interest to maritime fishing, because fish leave the too-warm waters of the Gulf of Guinea (24-30 deg C) that are low in salinity (33-34 parts per thousand), and lack plankton and other nutrients. Diffusion and mixing are reduced vertically by a thermocline at 30 m which is a zone preferred by fish. Bathythermograms indicate the zone does not mix with the Guinea water mass. (Llaverias-USGS)
W69-00138

BREVARD COUNTY, FLORIDA (BEACH EROSION CONTROL).
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 352, 74 p, 1968. 10 fig, 1 plate, 13 tab, 1 suppl, 1 append.

Descriptors: *Beach erosion, *Shore protection, *Coastal engineering, Dredging, Harbors, Jetties, Littoral drift, Florida.
Identifiers: Brevard County, Florida, Cape Canaveral, Cape Kennedy.

Investigation of beach erosion south of Canaveral Harbor, Florida, shows that the jetties and other harbor works are intercepting the southward littoral drift of sand and as a consequence erosion of the beaches of Brevard County is severe. Remedial measures proposed include development and protection of 2.8 miles of beach immediately south of Canaveral Harbor and at Indialantic and Melbourne Beach. Nourishment of the beach at the City of Cape Canaveral would be provided by a sand transfer plant which would restore the littoral drift now being intercepted by the harbor works. First costs are estimated to be $852,000 for the city of Cape Canaveral and $511,000 for Indialantic--Melborne Beach; estimated annual costs are $34,700 and $81,800 respectively. The plan is economically justified with benefitcost ratios of 5.9 for Cape Canaveral and 2.5 for Indialantic and Melbourne Beach. It is recommended that the Federal Installations at Cape Kennedy and Patrick Air Force Base also undertake remedial measures to be paid for by the Federal agencies involved. (Knapp-USGS)
W69-00242

RIVER CHANNEL BARS AND DUNES--THEORY OF KINEMATIC WAVES,
U. S. Geological Survey.
Walter B. Langbein, and Luna B. Leopold.
U S Geol Surv Prof Pap 422-L, pp L1-L20, 1968. 19 fig, 4 tab, 20 ref.

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Descriptors: *Sediment transport, *Sediment distribution, *Dunes, *Sand bars, Meanders, Model studies, Flumes.
Identifiers: *Kinematic waves.

A study of the movement of beads carried in moving water in a narrow flume, and of sand in a pipe or flume in dune movement shows that flux-concentration curves characteristic of kinematic wave movement can be constructed. From the kinematic point of view, concentration of particles in dunes and other wave bed forms results when particles in transport become sufficiently numerous or closely spaced to interact and reduce the effectiveness of the ambient water to move them. Field observations over a 5-yr period are reported in which individual rocks were painted for identification and placed at various spacings on the bed of an ephemeral stream in New Mexico, to study the effect of storm flows on rock movement. The data on about 14,000 rocks so observed show the effect of variable spacing which is quantitatively as well as qualitatively comparable to the spacing effect on small glass beads in a flume. Dunes and gravel bars may be considered kinematic waves caused by particle interaction, and certain of their properties can be related to the characteristics of the flux-concentration curve. (Knapp-USGS)
W69-00260

NUTRIENT AND ENERGY CYCLES IN AN ESTUARINE OYSTER AREA,
Dalhousie Univ, Halifax, Nova Scotia, Inst. of Oceanography.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00386

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

THE PROBLEM OF THE PALEOKARSTIC DAMMAM LIMESTONE AQUIFER IN KUWAIT,
Food and Agriculture Organization of the United Nations, Rome, and Dept. of Water and Gas, Government of Kuwait.
David J. Burdon, and Abdullah Al-Sharhan.
J Hydrol, Vol 6, No 4, pp 385-404, Aug 1968. 20 p, 2 fig, 2 tab, 21 ref.

Descriptors: *Aquifers, *Karst, Limestones, Water yield, Water quality, Paleohydrology.
Identifiers: Kuwait, Paleokarst, Dammam Limestone, Imported water.

A preliminary study of the Dammam Limestone shows that the karstic zones developed in Upper Eocene and Oligocene time should yield more water of better quality than zones of lower permeability. The Kuwait City and Ahmadi municipal well fields yield 27 million cubic meters of poor-quality water (4,000 ppm TDS). Further groundwater development is planned. It may be possible to use the anisotropic aquifer for storage of imported water. The piezometric surface of the aquifer was mapped, the general stratigraphy of Kuwait is shown in a table, and a cross section shows the Karstic nature and problems of development of the Dammam Limestone. (Knapp-USGS)
W69-00125

QUALITY OF SURFACE WATERS OF THE UNITED STATES 1960: PARTS 9-14, COLORADO RIVER BASIN TO PACIFIC SLOPE BASINS IN OREGON AND LOWER COLUMBIA RIVER BASIN.
U. S. Geological Survey.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00126

GROUND-WATER RESOURCES OF ACCOMACK AND NORTHAMPTON COUNTIES, VIRGINIA,
U. S. Geological Survey.
Allen Sinnott, and G. Chase, Tibbitts, Jr.
Virginia Dep of Conserv and Econ Develop, Div of Mineral Resources, Rep 9, 1968. 113 p, 7 fig, 4 plate, 8 tab, 25 ref.

Descriptors: *Groundwater, *Water resources, *Water wells, *Aquifers, *Virginia, Coastal plains, Water yield, Water quality.
Identifiers: *Accomack County, Virginia, *Northampton County, Virginia, Delmarva.

Groundwater resources of Accomack and Northampton counties, in the Virginia part of the Delmarva peninsula, were studied by the USGS and the Virginia Division of Mineral Resources. Mean annual temperature is 58 deg and the precipitation is 43 in. Thin surficial Pleistocene sands, and clays are underlain by Miocene deposits which supply most of the water for municipal and industrial uses. Chemical character of the deeper water suggests hydraulic connection with the artesian aquifers east of Chesapeake Bay. Domestic water is mainly from wells in the Pleistocene deposits. Larger wells are mainly in Miocene aquifers; one near Exmore yielded 746 gpm with 37 ft of drawdown, and one at Cape Charles yields 645 gpm. The water is good, moderately hard, and usually low in iron and fluoride. Deep Miocene wells yield water high in bicarbonate and fairly high in chloride. Withdrawal is not excessive anywhere and the supply is adequate for foreseeable needs. Well descriptions, aquifers, water levels, yields, and chemical analyses are tabulated. Maps, cross sections and a stratigraphic column show well location, geology, and stratigraphy. (Knapp-USGS)
W69-00127

PRELIMINARY REPORT ON THE WATER RESOURCES OF THE KAHUKU AREA, OAHU, HAWAII,
U. S. Geological Survey, Honolulu, Hawaii.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00130

PRELIMINARY REPORT ON THE WATER RESOURCES OF THE KAU DISTRICT, HAWAII,
U. S. Geological Survey, Honolulu, Hawaii.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00131

RECORDS OF NORTH-SIDE SPRINGS AND OTHER INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO, 1948-67,
U. S. Geological Survey.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00137

WATER RESOURCES AND SURFICIAL GEOLOGY OF THE HOMER AREA, SOUTH-CENTRAL ALASKA,
U S Geological Survey.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00140

CONTOUR FURROWING, PITTING, AND RIPPING ON RANGLANDS OF THE WESTERN UNITED STATES,
U. S. Geological Survey, Water Resources Div., Denver.
F. A. Branson, R. F. Miller, and I. S. McQueen.
J of Range Manage, Vol 19, No 4, pp 182-190, July 1966. 9 p, 12 fig, 25 ref.

Descriptors: *Mechanical equipment, Contour furrows, Ranges, *Grasslands, Crop response, Fine-textured soils, Vegetation, Precipitation intensity, Runoff, Altitude, Soil moisture, Moisture content, Salinity, Furrows, Reclamation states, Sediment control, Soil water movement, Halophytes.

During the growing season of 1964, the effects of mechanical treatment on rangelands administered by the Bureau of Land Management were measured in Montana, Wyoming, Colorado, Utah, New Mexico and Arizona. Variables evaluated in the study included kinds of mechanical treatments, soils, vegetation types, variation in precipitation, altitude, latitude and longitude. No well-defined relationship was found between annual precipitation and altitudes with respect to treatments. The purposes of mechanical land treatments were to reduce runoff, thereby increasing moisture storage for plant use, and to decrease sediment and water movement from treated sites. Salinity and pH did not appear related to treatment success. Medium- to medium-fine textured soils were the most suitable for mechanical treatment. The halophytic Nuttall saltbush responded more favorably to contour furrowing than did any other type sampled. Of the seven kinds of mechanical treatments, the contour furrowing and broadbase furrowing were the most effective. Treatment of winter fat resulted in a decrease in perennial grass production. (Blecker-Ariz)
W69-00147

AN EVALUATION OF FIVE APPLICATION METHODS FOR APPLYING EVAPORATION SUPPRESSANTS TO THE SURFACE OF SMALL WATER STORAGES,
Manitoba Univ., Agricultural Engineering Dept., Winnipeg.
H. M. Lapp.
Can Agr Eng, Vol 10, No 1, pp 17-22, May 1968. 6 p, 6 fig, 16 ref.

Descriptors: Emulsions, *Evaporation control, Hexadecanol, Octadecanol, *Monomolecular films, *Reservoir evaporation, Precipitation, *Application methods, Rates of application, Alcohols, Semiarid climates, Water storage, *Retardants, Wind velocity.

In semi arid regions, potential evaporation losses frequently exceed annual precipitation values. Seven methods were listed that could be employed to reduce evaporation from water storages. A review of evaporation suppression and the physical properties of monolayer materials was given. The five application methods evaluated were: manual powder, continuous emulsion, continuous solution, intermittent powder and continuous powder. The superior evaporation suppressant to date appears to be a mixture of approximately equal quantities of hexadecanol and octadecanol. A methyl alcohol based solution of about 5% concentration and a dry fine powder are suitable forms of evaporation suppressant for application to a water surface. An evaporation suppressant should be generated continuously from the upwind shore and at rates proportional to wind speeds to form an efficient monolayer for evaporation suppression. A continuous application of dry fine powder from a dispenser located on the upwind shore was judged to be the most practical and efficient method of applying an evaporation suppressant to small water storages. (Blecker-Ariz)
W69-00153

THE LAKE SUPERIOR WATERSHED UNIT.
Minnesota State Department of Conservation.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-00180

SIMULATION OF GREAT LAKES BASIN WATER SUPPLIES,
U. S. Lake Survey, Detroit and Inland Waters Branch, Ottawa, Canada.
Edmond Megerian and Ralph L. Pentland.
Water Resources Research, Vol 4, No 1, pp 11-17, February 1968. 7 p, 3 fig, 3 tab, 6 ref.

Descriptors: *Model studies, *Water supply, *Great Lakes, Mathematical models, Testing, Persistence.
Identifiers: *Net basin supply, Simulation studies, Two-station model, Multivariate model, Great Lakes Basin, Autocorrelation test.

The basic concept utilized in the simulation study is to statistically evaluate the recorded supplies in order to isolate the two components assumed to constitute the basin water supply: (1) that portion of the supply that is considered random, owing to chance interaction of unpredictable meteorological elements, and (2) that portion of the supply that is the result of the persistance due to natural storage in the lakes, soil, bedrock, and snow over the drainage basin. In this study, consideration was also given to the relationship between supplies in neighboring basins. These factors were used to formulate mathematical models for simulation of supplies to all of the Great Lakes simultaneously. Extensive statistical tests have been used to ensure that the statistical parameters and the time series characteristics of the simulated data resemble those of the recorded data. (Seneca-Rutgers)
W69-00201

CLIMATE AND STREAMFLOW OF PUERTO RICO,
U. S. Geological Survey, San Juan, Puerto Rico, Water Resources Division.
E. V. Giusti, and M. A. Lopez.
Caribbean J Sci, Vol 7, No 3-4, pp 87-93, Sept-Dec 1967. 7 p, 5 fig, 1 tab, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Puerto Rico, Streamflow, Climatology, Synoptic analysis.
Identifiers: Thornthwaite's method, Climatic index.

The presently available data on streamflow, runoff rainfall, and temperature of Puerto Rico are evaluated, although the period of record is very short, with a view to contributing to the knowledge of hydrology of tropical islands. The average annual streamflow in Puerto Rico is 56% of the annual rainfall, or 15% more than in the Eastern Piedmont of the U S where it is 30%. Climate is assumed to be responsible for this difference as well as for the differences of the flows of Puerto Rican streams which vary from 15 to 85% of the annual rainfall. Variations in the climate of Puerto Rico are shown by Thornthwaite's climatic index on a map of the Island, and the variations of the streamflow to rainfall ratios of Puerto Rican streams are shown to be related to Thornthwaite's climatic index. (Knapp-USGS)
W69-00253

RECESSION CHARACTERISTICS OF IOWA STREAMS,
Iowa Univ., Iowa City.
J. W. Howe.
Iowa State Water Resources Res Inst Bull 43, Iowa Univ, 32 p, 1968. 12 fig, 2 tab.

Descriptors: *Recession curves, *Streamflow forecasting, Iowa, Low flow, Surface-groundwater relationships.

The behavior of Iowa streams in low-water periods during the crop-growing season, May to Sept inclusive, was determined. The flow records in all such periods to 10 days or more in length were analyzed to determine recession constants. The results are shown on a map of the state and indicate a considerable uniformity of behavior during each of the summer months. The flow at the beginning of the periods was related to the area and soil permeability of the drainage basin and to the antecedent temperature and precipitation by means of correlation techniques. Data were obtained from the USGS, US Weather Bureau, and the US Soil Conservation Service. The lower parts of recession hydrographs with steady declines of at least 10 days were plotted using logarithmic discharge and linear time scales. The best straight line through the plotted points was constructed, breaks in slope were assumed to mark the beginning of groundwater flow, and recession constants were calculated. The recession constants were plotted on maps showing station locations. Observed and predicted discharges were plotted for May through Sept. Values of the recession constants and a summary of stations, data, and results are tabulated. (Knapp-USGS)
W69-00262

DISTRICT CONTROL OF WATER RESOURCES,
Detroit Univ Law School.
T. E. Lauer.
U of Detroit L J, Vol 37, No 1, pp 28-75, Oct 1959. 47 p, 344 ref.

Descriptors: *Water resources development, *Administration, *Water districts, Drainage districts, Levees, Flood control, Water policy, Administrative agencies, *Great Lakes region, State governments, Water management (Applied), Water supply.
Identifiers: Multiple-purpose districts, Single-purpose districts.

Water use law is not the only law directly affecting water resources-- 'water development law' is a second major area which is directed at group or community protection, and is based on cooperation instead of conflict. This article is concerned with water districts, a branch of water development law, with detailed emphasis on the developments in the Great Lakes States. Single-purpose districts are often used because needs arise and are recognized singularly. Drainage districts are usually established to drain potential farmland, and their powers were severely limited. Flood control, levee, and river improvement districts are usually established to allow participation in federally financed programs. Water supply districts, pollution control and sewage disposal districts, and various miscellaneous single-purpose districts are considered in detail. The modern tendency is toward multiple-purpose districts, which provide various economies. Conservancy and watershed districts and soil conservation districts are discussed, detailing Great Lakes States provisions. Advantages such as local control, and disadvantages such as financing problems are discussed in regard to districts. Problems involved in creating districts (i.e. geographical boundaries and scope of powers) are considered.
W69-00267

APPROACHES TO WATER RESOURCE DEVELOPMENT IN CENTRAL AND SOUTHERN FLORIDA, 1845-1947,
John M. DeGrove.
Florida Univ., Gainesville, 1958. 53 p.

Descriptors: *Federal government, *State government, *Land reclamation, Coordination, *Florida, Water resource development, Crops, Multiple-purpose projects, Legislation, Drainage practices, Navigation, Project planning, Flood control, Optimum development plans, Political aspects, Administration, Drainage districts, Soil properties, Crops.

This study consists of a selective survey of federal, state, local and private efforts to solve the water control problem of central and southern Florida from 1845 to 1947. It is selective because the study does not purport to be a general history of the subject during this period. Within a broad historical framework, specific kinds of problems are selected for analysis. These problems are concentrated within the general problem areas of administration, economics, and policy. The aim will be to attempt to discover whether experience in the evolution of the Florida project is useful in better understanding the general nature of the problems in the areas to be concentrated on. It is also hoped that by better understanding how present patterns in the administration, finance, and federal-state-local fields have evolved, it will be possible to face more realistically the task of making improvements in each of the areas treated.
W69-00268

OPTIMUM OPERATION OF A MULTI-RESERVOIR WATER SUPPLY SYSTEM,
Stanford University, Stanford, California.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00349

WATER QUALITY MANAGEMENT,
Univ of Oklahoma, Norman.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00355

3C. Use of Water of Impaired Quality

DUHON V BUCKLEY (SALINE WATER INTRUSION).

161 So 2d 301-307 (La 1964).

Descriptors: Louisiana, Judicial decisions, Salinity, *Rice farms, Oil wells, *Saline water-freshwater interfaces, Brine disposal, *Desalination, *Water pollution, Damages.

This was an action by four rice farmers against several owners of an oil well for damage to their rice fields, because the defendants had permitted salt water from their well to flow into the source from which plaintiffs pumped water for their rice fields. Defendants denied that their negligence caused any significant change in the salinity of the water source, and even if it had, that plaintiffs were contributorily negligent because they did not check for salt content before filling the rice fields. It was held that defendants' mine was the only possible source of salt water in the area, that the water in the rice fields and the water source was unusable for rice growing, and that plaintiffs did not have a duty to check for salinity before pumping water onto their fields. (Crabtree-Fla)
W69-00012

SOURCES OF SALINE WATER IN THE UPPER BRAZOS RIVER BASIN, TEXAS,
U. S. Geological Survey.
Jack Rawson, M. W. Flugrath, and Leon S. Hughes.

US Geol Surv Progr Rep to June 1967, Mar 1968. 163 p, 2 fig, 8 tab, 23 ref.

Descriptors: *Saline water, *Water pollution sources, *Texas, Data collections, Water quality, Discharge (Water), Water wells, Oil fields.
Identifiers: Brazos River Basin, Texas.

Sources of salt in Brazos River, west-central Texas, were studied to determine the best means of alleviating saline-water problems in connection with developing the basin's water resources. The Brazos above Possum Kingdom Reservoir is too saline for most uses; in the reservoir the salinity is usually over 1,200 ppm. The upper Brazos contributes only 18% of the total river flow, but about 55% of TDS, 85% of the chloride, and 75% of the sulfate. Poor water quality is due principally to inflow of natural brine, solution of calcium sulfate from soil and rocks, and pollution by oil field brine. Salt yields, chemical quality records, chemical analyses of stream water, records of wells and streams, annual discharge summaries, annual water quality summaries, quality of Possum Kingdom Reservoir water, and hypothetical reservoir water quality based on partial control of natural salinity, are tabulated. The major salt-contributing areas are described in detail. One stream, Salt Croton Creek, contributes about 27% of the dissolved solids, 42% of the chloride, and less than 5% of the sulfate to Possum Kingdom Reservoir. (Knapp-USGS)
W69-00136

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GEOLOGIC FACTORS IN COMMUNITY DEVELOPMENT AT NAPERVILLE, ILLINOIS,
Illinois State Geological Survey.
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00183

WATER PROBLEMS IN THE SPRINGFIELD-HOLYOKE AREA, MASSACHUSETTS - A LAYMAN'S LOOK AT WATER IN THE METROPOLITAN AREA,
U S Geological Survey.
J. C. Kammerer, and H. L. Baldwin.
Geological Survey Water-Supply Paper 1670 pp 30-68, 1963. 39 p. 5 fig, 10 photo, 3 dwg, 4 tab, 26 ref, 1 append.

Descriptors: Rivers, Groundwater, Hardness (Water), Iron, *Water pollution control, *Water users, Interstate commissions, Water pollution effects, Water pollution sources, Industrial wastes, Sewage treatment, Pre-treatment (Water), Sewage treatment, *Water rates, *Water requirements, *Recreation, Recirculated water, Public health.

Mineral content of area water, with the exception of iron, is not a problem. Sanitary sewage and industrial wastes cause pollution, and the larger streams are often polluted. Water is classified according to its sanitary condition. The three area rivers are condition 'D', or, suitable for transporting wastes without nuisance. Polluted water is fit for some industrial purposes. Some area cities do not treat their sewage. Ground water quality varies. The pollution-control program of Massachusetts aims at primary treatment of all wastes and sewages. There are 420,000 plus people and about 900 manufacturing industries in the area. Seven public water systems provide an average of 60 million gallons a day from reservoirs and wells. Water costs are about average. The flow of the Connecticut River is regulated by reservoirs and hydroelectric power plants. Recreational use is increasing. Total area water use amounts to 400 million gallons a day. One way to save water is to recirculate it, another is to build multiple-purpose reservoirs.
W69-00293

TOWARDS ECONOMIC EVALUATION OF WATER QUALITY IN IRRIGATION,
Harvard Univ, Cambridge, Mass; Colorado State Univ, Ft. Collins.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00345

INTERACTION OF SALINE WATER IRRIGATION AND NITROGEN FERTILIZATION ON CORN PRODUCTION IN CALCAREOUS SOILS,
Desert Inst., Egypt Soils Dept.
M. A. Abdel Salam, and S. A. el Nour.
J Soil Sci (UAR), Vol 5, No 2, pp 120-133, 1965. 13 p, 7 tab.

Descriptors: *Saline water, *Irrigation water, *Corn (Field), *Calcareous soils, Fertilizers, *Nitrogen, Plant growth, Crop production, Salinity, Adsorption, Lysimeters, Mineralogy, Soil chemistry, Ions, Sodium, Osmotic pressure.
Identifiers: United Arab Republic, Ionic composition, Fresh weight, Dry weight.

Variation in yield and mineral composition of corn grown in calcareous loamy soil, irrigated with solutions of varying total and relative salt levels and fertilized with gradual amounts of nitrogen was studied in the United Arab Republic. Salinity levels of 1, 2, and 3 atm of osmotic pressure; sodium adsorption ratios of 2.7, 19.3, and 51.2 and nitrogen levels of 50, 150, and 250 kilograms of ammonium nitrate were utilized. Significant differences were obtained in yield and mineral composition for both salinity and the sodium adsorption ratio. Adverse effects of increased salinity on crop yield decreased progressively with the nitrogen level applied. Maximum decrease in yield was associated with the highest ESP values where solutions of 3 atm osmotic pressure and 51.2 SAR were added. (Affleck-Ariz)
W69-00361

FUTURE QUANTITY AND QUALITY OF COLORADO RIVER WATER,
Leeds, Hill and Jewett, Inc, San Francisco.
Raymond A. Hill.
J Irrig and Drainage Div (ASCE), Vol 91, No IR 1, Proc Paper 4244, pp 17-30, March 1965. 14 p, 15 tab.

Descriptors: *Colorado River, *Water quality, *Salts, River flow, Water supply, Water chemistry, *Withdrawal, Colorado River Compact, Mexican Water Treaty, Salt balance, Consumptive use, *River forecasting, Water demand.
Identifiers: *Salt burden.

The Colorado River water used in California, Arizona and Mexico currently (1964) contains approximately 0.9 tons of salt per acre foot. It was predicted that progressive depletions in the natural flow of the Colorado River by upstream developments will have little effect on the total salt burden but a pronounced effect in the future on the unit concentrated of salts in the river water available for use. It was concluded that the water supply available in the Colorado River for use in the Lower Basin and in Mexico will shrink during the next 30 years from an average of 11,800,000 to approximately 8,000,000 acre feet per year. The chemical quality of the waters of the Colorado River was expected to fall far below present accepted standards. (Affleck-Ariz)
W69-00363

PROGRESS IN WASTE WATER RE-USE IN SOUTHERN CALIFORNIA,
Los Angeles County Sanitation Districts.
John D. Parkhurst.
J Irrig and Drainage Div (ASCE), Vol 91, No IR 1, Proc Paper 4253, pp 79-91, March 1965. 13 p, 3 fig, 1 tab.

Descriptors: California, *Water reuse, *Waste water (Pollution), Water supply, *Water quality, Industrial wastes, *Reclaimed water, Irrigation water, Recharge, Sanitary engineering, Water resources development, Sewage treatment, Economic feasibility, Alkylbenzene sulfonates, Public health, Domestic wastes, Detergents.

Water re-use in the Los Angeles area was planned to furnish a supplemental water supply in a water deficient area. It was found that suitability of waste water for re-use depended on the water supply quality and the character of industrial waste pollutants. Detailed planning was necessary for effective water re-use. Plans for water re-use developments in the Los Angeles area by the Sanitation Districts was presented. It was found that reclaimed water could be used for such purposes as industrial use, irrigation water for forage crops, cotton, nursery stock, field crops, parks, golf courses, and recharging underground water basins. (Affleck-Ariz)
W69-00371

THE EFFECT OF SALINE IRRIGATION WATER WITH DIFFERENT SODIUM AND CALCIUM CONCENTRATIONS ON SOME SOIL PROPERTIES,
Ain Shams Univ., Egypt, Soils Dept.
H. Hamdi, S. Youssef, and M. M. El Mansey.
J Soil Sci (UAR), Vol 6, No 1, pp 63-71, 1966. 8 p, 5 tab.

Descriptors: *Saline water, Irrigation effects, *Irrigation water, Sodium, Calcium, *Soil chemical properties, *Cation exchange, *Chemical analysis.
Identifiers: United Arab Republic, *Na : Ca ratios.

An investigation was conducted to determine the effect of using irrigation waters of varying total salt concentrations with different Na:Ca ratios on a clay loam and a sandy soil in the United Arab Republic. Irrigation waters used on the pots contained total salt concentrations of 1,000, 2,000 and 3,000 ppm and Na:Ca ratios of 2:1, 3:1 and 4:1. Results showed that total soluble salts, soluble sodium, calcium and chloride increased in the 1:5 soil water extract with both soils. Soluble sodium increased with higher Na:Ca ratios while soluble Ca decreased and Cl remained constant in both soils. (Affleck-Ariz)
W69-00373

THE EFFECT OF USING DIFFERENT CONCENTRATIONS OF SALINE WATER CONTAINING DIFFERENT Na : Ca RATIOS ON THE GROWTH AND CHEMICAL COMPOSITION OF ALFALFA,
Ain Shams Univ., Egypt. Soils Dept.
H. Hamdi, S. Youssef, and M. M. Elmansey.
J Soil Sci (UAR), Vol 6, No 2, pp 131-143, 1966.

Descriptors: *Saline water, *Irrigation water, Absorption, Plant growth, *Alfalfa, Crop production, *Ions, Nutrients.
Identifiers: United Arab Republic, Ionic concentration, Dry weight, Na:Ca ratios.

The effect of irrigation waters with varying Na:Ca ratios upon the growth and nutrient uptake of alfalfa was studied in the United Arab Republic. Two soils, one a clay loamy type and the other a sandy type, were utilized. Pots sown with alfalfa were treated with irrigation water containing total salt concentrations of 1,000, 2,000 and 3,000 ppm and three different ratios of Na:Ca namely 2:1, 3:1 and 4:1. The control group received distilled water. Alfalfa yield was decreased as the salt concentration increased and the plants showed an increase in Na super +, Ca super ++, and Cl super - contents but a decrease in K super +. Increase of salt concentration also resulted in decreased Ca super ++, Na super +, and K super + uptake and an increased Cl super - uptake. As the Na:Ca ratio was increased plants showed an increase in Na while Ca super ++ and Cl super - contents remained constant. (Affleck-Ariz)
W69-00383

INTERACTION OF SALINE WATER IRRIGATION AND PHOSPHOROUS FERTILIZATION ON CROP PRODUCTION,
Desert Inst., Soils Dept., Egypt.
M. A. Abdel Salam, and A. Z. Osman.
J Soil Sci (UAR), Vol 5, No 2, pp 75-87, 1965. 13 p, 6 tab.

Descriptors: *Irrigation water, *Saline water, *Fertilizers, Alfalfa, Barley, Sodium, Adsorption, *Crop production, Ions, Soil analysis, *Mineralogy, Salinity.

The effect of interaction between phosphorous fertilization and saline water irrigation on the growth and mineral composition of alfalfa and barley was studied in the United Arab Republic. A calcareous loamy soil and a clay soil were treated with tagged (P super 32) superphosphate fertilizer and utilized in earthenware pots then sown with alfalfa and barley. They were irrigated with solutions of salinity levels of 1, 2, and 3 atm osmotic pressure and sodium adsorption ratios of 2.7, 19.3, and 51.2. Differences in yield and mineral composition were caused by both salinity and sodium adsorption ratio. The salinity level in irrigation waters adversely affected the percentage of phosphorous derived from fertilizer. (Affleck-Ariz)
W69-00384

3D. Conservation in Domestic and Municipal Use

SURFACE WATER RESOURCES PLANNING IN HUDSON BASIN,
Tippetts-Abbett-McCarthy-Straton, Consulting Engrs., New York, N. Y. and Div. of Water

Resources, N. Y. State Conservation Dept., Albany, N. Y.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00198

ON THE MARGINAL COST PRICING OF MUNICIPAL WATER,
New Mexico Univ., Albuquerque.
For primary bibliographic entry see Field 06C.
For abstract, see .
W69-00203

3E. Conservation in Industry

CHAUTAUQUA CO FED'N OF SPORTSMENS CLUB V CAFLISCH (MILL DAMS).
State of New York.

15 App Div 2d 260; 222 N Y S 2d 835-840 (1962).

Descriptors: Dam, *Mill dams, Electric power, Ponding, Conservation, *Wildlife conservation, Habitat improvement, Impounded waters, Water level fluctuations, Water law, Water levels, Flooding, Fish conservation, New York, Water policy, Running waters, Surface water, Natural flow.

The issue on appeal was whether the plaintiff had the right, by grant and by prescription, to raise and maintain the waters of Jaquins Pond for any lawful purpose or use, including conservation purposes, to a normal level. The court considered what rights the plaintiff acquired by the terms of the conveyances from its grantor and through him from his predecessors in title. No document that conveyed the property in question conveyed any right to use the waters impounded by the dam except for the purpose, express or implied, of operating machinery. The plaintiff conceded that the use of the impounded waters had nothing to do with the operation of machinery, but is solely for conservation purposes. The court stated that the express and unambigous language of the grant to plaintiff revealed an intention to limit the use of the water impounded by the dam to the operation of machinery and it must be given effect. The court reversed the trial court and held that the uplands may not be flooded for conservation purposes under the terms of such a grant. (R. Smith-Fla)
W69-00031

3F. Conservation in Agriculture

IRRIGATION REGIME OF SOILS REQUIRING RECLAMATION,
Academy of Sciences, USSR, V V Dokuchayev Institute of Soil Science.
I. P. Komyagin.
Pochvovedeniye, No 11, pp 66-73, Nov 1967. 7 p, 2 tab, 22 ref. Soviet Soil Science, Transl by Scripta Technica, Inc, pp 1488-1494, Aug 1968.

Descriptors: *Irrigation, *Crop production, *Land reclamation, Soil structure, Precipitation intensity, Translations.
Identifiers: *USSR, Soil compaction, Irrigation regime.

The influence of irrigation regimes on soils in relation to productivity in the USSR is briefly discussed. It was observed that when the amount of precipitation was large and soil compaction heavy, as in the Izobil'noye region, the equilibrium compactness was considerably less, and vice versa. Judgements of the effects of different methods of irrigation on the soil immediately after water is applied cannot be adequately evaluated. For example, soil structure is damaged to a greater extent by flood irrigation than by sprinkling or by furrow irrigation. Success in improvement of soils depends on the proper selection of irrigation regime. Experiments involving increased depth of soil wetting by irrigation have resulted in increased yields of crops. This is demonstrated in the southern Ukraine where 4 irrigations during the growing season resulted in marked increase in yields of tomatoes and other crops. (Llaverias-USGS)
W69-00102

EFFECT OF STRAW MULCH RATES ON SOIL WATER STORAGE DURING SUMMER FALLOW IN THE GREAT PLAINS,
B. W. Greb, D. E. Smika, and A. L. Black.
Soil Sci Soc Amer Proc, Vol 31, No 4, pp 556-559, July-August 1967. 4 p, 1 fig, 5 tab, 17 ref.

Descriptors: Arid climates, *Stubble mulching, Moisture availability, Precipitation, *Soil moisture, Fallowing, Wheat, *Water storage, Mulching, *Great Plains, Evaporation control, Soil profiles.
Identifiers: *Straw.

The effect of defined rates of straw mulch on soil water storage fallow was studied. Soil water storage data from three experiments which were being conducted within the Great Plains area utilizing various known quantities of initial rates of straw were presented. Each experiment included an alternate crop and fallow block of plots utilizing winter wheat (Triticum aestivum L) as a source of straw. The length of summer fallow averaged 14 months. In all cases, initial available soil water was relatively low at wheat harvest (beginning of fallow). Soil water differences were evident at all locations by early spring. Net gains of soil water at the end of fallow as credited to increasing quantities of straw mulches varied from 1.0 to 4.3 cm at Sidney, Montana, 2.1 to 4.1 cm at Akron, Colorado and 1.3 to 3.3 cm at North Platte, Nebraska. More than 70% of the net gains in soil water under heavier amount of mulch was found below the surface 61 cm of the soil profile at all locations, thereby minimizing potential evaporation losses. Since wheat is grown in arid climates, the principles and practices studied could be applied to this particular climate. (Blecker-Ariz)
W69-00144

THE WATER BUDGET OF IRRIGATED PASTURE LAND NEAR MURRAY BRIDGE, SOUTH AUSTRALIA,
Australia Dept. of Agriculture, Adelaide.
For primary bibliographic entry see Field 02G.
For abstract, see .
W69-00150

STUBBLE MULCH INCREASES AMOUNT OF MOISTURE STORED IN SOIL,
South Dakota State Univ.
Earl Adams.
Crops and Soils Mag, Vol 20, No 7, pp 30, April-May 1968. 1 p.

Descriptors: *Stubble mulching, Moisture availability, Wind erosion, *Soil erosion, Precipitation, Evaporation, *Soil moisture, Fallowing, Topsoil, Field capacity, Water storage, Mulching.

Stubble mulching is a good way to reduce wind and water erosion on grain fields. Stubble mulched fields may store as much as 30% more moisture for the next crop in areas where annual precipitation is between 12-13 inches in Montana. Data indicated that the heavier the mulch, the less the surface evaporation and the deeper the moisture penetrates the soil profile. The total soil moisture gain for the 21 months in which the land was in fallow ranged from 2.9 inches for bare fallow up to 4.3 inches for the heaviest mulch. An important side effect of the mulch treatments is the amount of topsoil saved that might have otherwise been lost through soil erosion by wind and water. (Blecker-Ariz)
W69-00152

AN EVALUATION OF FIVE APPLICATION METHODS FOR APPLYING EVAPORATION SUPPRESSANTS TO THE SURFACE OF SMALL WATER STORAGES,
Manitoba Univ., Agricultural Engineering Dept., Winnipeg.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-00153

STABILIZING AND MANAGING MALLEE SANDHILLS,
Wanbi Research Centre, Australia.
P. D. Guerin.
J of Agr of S Australia, Vol 69, No 8, pp 305-309, March 1966. 5 p, 5 photo.

Descriptors: *Dunes, Wind erosion, *Soil stabilization, Sands, *Arid climates, *Vegetation establishment.

Treatment of the long sand ridges that occur throughout the sandy mallee farming areas is an important aspect of farm management in South Australia. The basic principle in treating vulnerable sandhills in arid climates is that the plant cover must be both established and maintained. The two classes of sandhills are the low to medium sandhills which, when properly stabilized, may be cropped and managed with the remainder of the paddock, and secondly the sandhills with large, steep ridges which should be fenced out. Cereal rye has proved to be the most outstanding vegetation cover for initial stabilization of sand drift. The most satisfactory species for permanent cover on sandhills are lucerne and perennial veldt grass. (Blecker-Ariz)
W69-00154

WATER USE IN LARGE SCALE IRRIGATION SCHEMES,
Irrigation Research Lab., Griffith, New South Wales, Australia.
E. R. Hoare.
XVII Int Hort Congr Proc, Vol 2, pp 105-112, 1967. 8 p, 1 fig, 1 tab.

Descriptors: Semiarid climates, Trees, *Fruit crops, *Solar radiation, Humidity, Soil moisture, Crop production, Water utilization, Salinity, *Irrigation practices, Water loss, *Orchards, Soil-water-plant relationships, *Crop response, Moisture stress.
Identifiers: *Penman's formula.

The semi arid areas of the world have been ideally suited to the growing of tree fruit due to higher sunlight intensity, suitable soils and low humidity. Prior to the 1940's, the approach to water usage by plants was botanical in concept. Penman's formula was discussed in terms of water losses that would occur in an orchard. The interaction of soil and plant with respect to soil moisture content and crop yield as related to the plant's water stress were discussed. If an orchard was planted in some remote arid area of the world, with the data given it is possible to calculate within 20% the full water requirements of that crop. The effects of salinity on the amount and frequence of irrigation were discussed. (Blecker-Ariz)
W69-00155

COMPETING USES FOR WATER AND OTHER IMPEDIMENTS TO IRRIGATION DEVELOPMENT,
North Dakota State Univ., North Dakota Water Resources Institute.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00192

WATER SUPPLIES, IRRIGABLE SOILS AND TRENDS IN IRRIGATION DEVELOPMENT,
Dept. of Agriculture, Economic Research Service.
Norman E. Landgren, and John W. Putman.
Great Plains Agricultural Council, Publication No 30, pp 7-19, Nov 1967. 13 p, 3 fig, 2 map, 3 tab, 2 ref.

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Descriptors: Federal Government, *Irrigated land, *Water policy, Central U. S., Subsurface waters, Water utilization, *Supply, Bodies of water, *Water demand.
Identifiers: Economics, *Irrigation.

This paper examines the trends in irrigation. Even though there has been rapid expansion of irrigation, physical potentials for further development exist. The amount of irrigable lands in the Great Plains States is related to the cropland harvested. Studies suggest that there may be ten million acres available for irrigation for which there are reasonable prospects of supplying water. The development of this potential irrigable acreage should be done by public agencies. The public interest will not be satisfied solely by the development of irrigable acreage since demands from non-agricultural uses of water exists, and these demands will increase in the future. Therefore, the development of water resources for irrigation purposes will have to be judged in relation to other beneficial uses. (Grossman-Rutgers)
W69-00193

IRRIGATION IN THE FUTURE,
Leeds, Hill and Jewett, Inc., Cons Engrs, San Francisco, California.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00195

FRAMEWORK FOR ANALYSIS OF IRRIGATION DEVELOPMENT,
Oklahoma State Univ., Stillwater, Department of Agricultural Economics.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00196

HYDROLOGIC ASPECTS OF NO-TILLAGE VERSUS CONVENTIONAL TILLAGE SYSTEMS FOR CORN PRODUCTION,
Virginia Polytechnic Institute, Blacksburg.
V. O. Shanholtz, and J. H. Lillard.
OWRR report A-009-Va, Virginia Water Resource Research Center, Bull No 4 June 1968, 31 p, 6 figs, 8 tab, 45 ref.

Descriptors: Water conservation, Evapotranspiration, *Soil-water-plant relationships, *hydrologic budget, *Mulching, Evaporation control, Runoff, Moisture availability, Droughts, *Moisture content, Hydrologic models.

The hydrologic aspects of no-tillage and conventional tillage systems for corn production are compared. Differences in available soil moisture content are discussed with respect to water use efficiency, droughts, and yields. A mathematical model for simulating plant available soil moisture is presented. (Shanholtz-Va Tech)
W69-00231

MANAGEMENT: A KEY TO IRRIGATION EFFICIENCY,
Dep of Agriculture, Phoenix, Arizona, Agricultural Research Service.
Leonard J. Erie.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR3, Pap 6107, pp 285-293, Sept 1968. 9 p, 4 tab, 2 fig, 10 ref.

Descriptors: *Water management (Applied), *Irrigation practices, *Water consumption (Plants), *Water loss, Evapotranspiration, Water utilization, Soil-water-plant relationship, Conservation.
Identifiers: *Irrigation efficiency, Crop irrigation.

Water consumption and efficiency of crop irrigation are discussed with relation to management. Water losses that occur in transporting from sources to ultimate irrigation sites are described, and some unavoidable water losses in management procedure are identified. Comparisons are made between various water uses, particularly those in industry and agriculture, and consumptive use data are discussed relative to conservation. Because irrigated agriculture accounts for 80%, or more, of all water consumed in the U S, the greatest opportunity for water conservation exists in good irrigation management. About 60% of the water withdrawn for irrigation is lost through evapotranspiration, and another large percentage is not otherwise beneficially used by plants. Inefficient application occurs because of lack of knowledge about soils, root systems, and consumptive use estimates by the manager. (Lang-USGS)
W69-00233

STABLE ALKANOL DISPERSION TO REDUCE EVAPORATION,
Dept. of Agriculture, Phoenix, Arizona, Water Conservation Lab.
Gary W. Frazier, and Lloyd E. Myers.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR1, Pap 5849, pp 79-89, Mar 1968. 11 p, 3 fig, 2 tab, 14 ref.

Descriptors: *Evaporation control, *Alcohols, *Monomolecular films, *Surfactants, *Dispersion, Suspension, Solvents, Hexadecanol, Octadecanol.
Identifiers: Alkanols.

Highly stable sol- or gel-type dispersions of long-chain alkanols in water have been prepared and shown to be more effective than powdered alkanol in reducing evaporation from water surfaces. Surfactants used to prepare the dispersions are algicides and bactericides. Dispersion samples have shown no separation or deterioration after 5 yr storage under nonsterile condit ons. Concentrated dispersions can be prepared for shipment or storage and can be diluted with water containing up to 1,700 ppm soluble salts to make stable, low-viscosity dispersions for application with simple drip-type applicators. Film release rates and film pressures from dispersions exceed those from powder. Fifty pounds of powdered alkanol per acre per month r duced evaporation from outdoor tanks by 15% under adverse testing conditions. Under the same conditions only 10 lb of dispersed alkanol per acre per month reduced evaporation by 28%. (Author)
W69-00249

CONSUMPTIVE USE DERIVED FROM EVAPORATION PAN DATA,
USAID, Bogota, Columbia.
George H. Hargreaves.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR1, Pap 5863, pp 97-105, Mar 1968. 9 p, 5 tab, 10 ref.

Descriptors: *Evapotranspiration, *Evaporation, *Consumptive use, *Climatic data, Irrigation programs, Rainfall, Evaporation pans.
Identifiers: Irrigation requirements, Evapotranspiration calculations.

Evapotranspiration measurements or computations provide basic information for the computation of irrigation requirements. Unfortunately, in underdeveloped or developing countries both evapotranspiration and weather data are usually of limited availability and for some proposed project areas nonexistent. Formulas and methods are required by engineers working on design and development of irrigation. These must permit the evaluation of needs and requirements for irrigation with an absolute minimum of data. Formulas are given for computing evaporation from climate data. Ratios of evapotranspiration to Class A pan evaporation are given for a large number of crops. Crops are grouped together or assigned general classifications whenever possible. Consumptive use coefficients converting evaporation to evapotranspiration are given by 10% increments of the crop growing season or vegetative cycle. A method of computing utilizable rainfall is presented and a formula is given for converting evapotranspiration to irrigation requirements. Irrigation requirements may be computed with several levels of data availability if temperature and rainfall measurements at the disposal of the engineer constitute the minimum of data required. (Author)
W69-00252

WATER RIGHTS IN LOUISIANA,
Louisiana Law Review, Baton Rouge.
Jerry G. Jones.
La L Rev, Vol 16, No 3, pp 500-511, Apr 1956. 12 p, 49 ref.

Descriptors: Louisiana, Civil law, Water law, Water rights, Administrative agencies, State jurisdiction, Irrigation, Legislation.

Article 661 of the Civil Code, a typical expression of riparian doctrine, allows water usage only to those whose land abuts a stream. This basic legislation has been supplanted in areas where irrigation is controlled by administrative agencies. The enactment of R S 9:1101 declaring all waters to be the property of the State of Louisiana with the privilege of use by everyone further complicates the picture. If 661 is construed as unaffected by this legislation, an application of the general rules of servitude still yield many inequitable results, e g prohibition against riparian owner's use of water to serve non-riparian lands ajoining his riparian estate, but which have been purchased subsequent to the initial exercise of the servitude. Comprehensive legislation is needed to eliminate present doubt and conflict.
W69-00266

PROBLEMS OF FEDERALISM IN RECLAMATION LAW,
Colorado Univ. Law Review, Boulder.
Joseph L. Sax.
U Colo L Rev, Vol 37, No 1, pp 49-84, Fall 1964. 36 p, 157 ref.

Descriptors: *Federal Reclamation Law, *Federal-state water rights conflicts, Recreation, United States, State jurisdiction, *Compensation, Water reuse, States, Water policy, Reclamation, Irrigation, *Water allocation (Policy), Competing uses, Judicial decisions.
Identifiers: Federal Farm Policy, Surplus Crops.

The problems raised here center on Section 8 of Reclamation Act of 1902. This section delineates the rights reserved to the states where a Federal reclamation program is in force. Section 8 was originally interpreted to place state law above federal law whenever a conflict occurred. Recent cases indicate by dicta that the section now should be read so as to give state law priority only in situations concerning compensation for the loss of private property rights. Brief attention is paid to various legislation such as the Boulder Canyon Project Act, the Warren Act, the Reclamation Extension Act, and the Fryingpan-Arkansas Project law. Extensive analysis of the legislative history of the Reclamation Act is provided. The role of the Dept. of Interior in the area of recreation in water areas is discussed, with a conclusion that it will play a quite active role both in policy planning and administration. The relationship between the Reclamation Acts and Federal Farm policy is discussed with the conclusion being that Congress intended to utilize the reclamation laws to promote farm policy.
W69-00294

THE IRRIGATION DEMAND PHASE OF THE WATER SUPPLY AND DEMAND PROJECT (SECTION I: IMPROVING THE DESIGN OF ECONOMIC IRRIGATION SYSTEM - CROP RESPONSE),
Cornell University, Ithaca, N. Y., Agricultural Engineering Dept.
Gilbert S. Levine, J. Kampen, and I. Seginer.
OWRR Project No. A-001-NY, Technical Report No. 14, Cornell Water Resources and Marine Sciences Center, September 1968. 21 p, 6 fig, 7 tab.

Descriptors: Irrigation design, *Soil-water-plant relationships, *Evapotranspiration, *Crop response, Potatoes, Forage mixtures, Vegetable crops.

The yield responses of 8 vegetable crops, potatoes, and a variety of forages to additions of water were determined from past research in 5 Northeastern U.S. states. A relatively simple analysis and interpretation scheme revealed some generalizations: (1) for most vegetables there is a positive correlation between yield and water added; (2) the rate of yield response decreases when the water added is excessive, and may become negative; (3) this break point is approximately 13 in. for short season crops, 20 in. for potaotes and 20 to 22 in. for forages. Yield response of forages is between 0 and 500 lbs per inch of water used. (Levine-Cornell)
W69-00311

THE USE OF WATER BY COTTON CROPS IN ABYAN, SOUTH ARABIA,
Empire Cotton Growing Corp., Namulonge, Uganda.
D. A. Rijks.
J Applied Ecol, Vol 2, No 2, pp 317-343, Nov 1965. 27 p, 13 fig, 5 tab, 28 ref.

Descriptors: *Evaporation, *Cotton, Irrigation practices, *Rates of application, Water balance, Soil moisture, *Moisture content, *Energy budget, Temperature, Humidity, Crop production, Soil physical properties, Soil profiles, Meteorological data, Water utilization.
Identifiers: South Arabia, *Energy balance.

The object of a study conducted in South Arabia was to estimate by two methods, the actual evaporation from cotton crops grown under four different rates of irrigation. Evaporation was estimated from water balance studies, which took into account rainfall, irrigation and changes in soil water content. A second estimate was obtained by combing measurements of the energy balance over cotton with the temperature and humidity profiles in and above the crop. The four rates of irrigation, applied before sowing were 15, 45, 60 and 90 cm of water which resulted in the crops using 14, 34, 46 and 67 cm of water respectively. A relation between the decrease in yield and time of onset of water strain was presented. It was concluded that the most efficient use of water resulted when irrigation rates were adjusted to provide 50 cm of available water. (Affleck-Ariz)
W69-00367

INFLUENCE OF SOIL TEXTURE AND RAINFALL ON THE RESPONSE OF COTTON TO MOISTURE REGIME,
Lower Rio Grande Valley Research and Extension Center, U. S. Dept. of Agriculture, Weslaco, Texas.
C. J. Gerard, and L. N. Namken.
Agron J, Vol 58, pp 39-42, Jan-Feb 1966. 4 p, 5 fig, 3 tab.

Descriptors: *Soil texture, Rainfall, Crop response, *Cotton, Root distribution, *Soil moisture, Texas, Rates of application, Irrigation water, Arid lands, *Soil physical properties, Fine-textured soils, *Crop production.
Identifiers: Medium-textures soils, *Moisture regime.

A paper was presented which discussed the influence of soil texture and related rooting characteristics and of rainfall on the response of cotton to different soil moisture regimes in the Lower Rio Grande Valley of Texas. Cotton on medium textured soils developed an extensive root which was able to extract water to depths of 4 to 5 feet, while on fine-textured soils cotton was only able to extract water to 2 feet. On medium-textured soils cotton needed only 1 or 2 irrigations to produce satisfactory yields. It was found that cotton on fine-textured soils needed to be irrigated every 10 to 15 days starting at the first bloom. This study will provide important information for arid regions in that the best time to use a limited supply or irrigation water can be determined. (Affleck-Ariz)
W69-00374

OPTIMAL TIMING OF IRRIGATION,
California Univ., Riverside, Dept. of Engineering.
Warren A. Hall, and William S. Butcher.
Nevada Univ., Reno, Dept. of Engineering Affiliate Inst. J Irrig and Drainage Div (ASCE), Vol 94, No IR 2, Proc Paper 5993, pp 267-275, June 1968. 8 p.

Descriptors: *Irrigation efficiency, *Timing, *Dynamic programming, *Optimization, Yield equations, *Mathematical models, Water supply, Irrigation water, Analytical technique, Rates of application, Growth stages, Cost-benefit analysis, Water distribution, Supplemental irrigation.

A methodology was derived permitting determination by dynamic programming of the optimal timing of irrigation, to produce the greatest net return inclusive of the cost of irrigation. It was particularly useful under conditions in which seasonal supply was inadequate but reasonably predictable. The analysis was based on the principle that the adverse effects of deficiencies (nutrition, excessive salinity and soil moisture) were geometric when existing in combination. For general use, additional data concerning the yield coefficients will be required covering each of the critical stages in the growth of the crops independently. (Affleck-Ariz)
W69-00375

EFFECT OF RECLAMATION SYSTEM AND CULTIVATION ON THE DISTRIBUTION OF SALINITY AND ALKALINITY IN SOIL PROFILES IN AN AREA IN NORTHERN PART OF THE NILE DELTA,
Cairo Univ., Cairo, Egypt, Soils Dept.
Abdella Zein el Abedene, Amin Abdel Barr, and A. M. el Akyabi.
J Soil Sci (UAR), Vol 5, No 2, pp 89-109, 1965. 21 p, 7 tab, 5 fig.

Descriptors: *Land reclamation, *Cultivation, *Salinity, *Alkalinity, *Soil profiles, Soil chemical properties, Groundwater, Salts, Sampling, Chemical analysis, Ions, Sodium, Adsorption, Solubility.
Identifiers: United Arab Republic, *Cations, *Anions.

The effect of reclamation and cultivation upon chemical properties of the soil was studied in the northern Nile Delta. Ten profiles from five localities in a cultivated area and also an adjacent barren area were studied. By comparison, it was shown that salt content in the cultivated soil crust decreased from 8.19 to 0.58 m/mhos. An accumulation of salt was found at approximately 20 cm below the soil surface in cultivated soil unlike the gradual decrease of uncultivated soils. The ground water salinity of cultivated soils was 1.3 to 31.5% of the salinity of barren soils. It was also shown the cultivated soil was more alkaline due to removal of salt giving higher values for pH, exchangeable sodium percentage, soluble sodium percentage and Na/Ca + Mg ratios. (Affleck-Ariz)
W69-00376

SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGEBRUSH WITH 2,4-D,
Rocky Mountain Forest and Range Experiment Station, Laramie, Wyoming.
Ronald D. Tabler.
J Range Management, Vol 21, No 1, pp 12-15, January 1968. 4 p, 4 fig.

Descriptors: *Soil moisture, *Spraying, Vegetation regrowth, *Evapotranspiration control, Nuclear moisture meters, Soil profiles, *Sagebrush, *Crop response, Grasses, Soil moisture meters, Moisture content, Sampling, Water loss, *2-4 D, Herbicides.
Identifiers: Plots.

This study's primary objective was to determine responses of the soil moisture regime to spraying big sagebrush. Measurements were made over a period of 3 years following treatment, as grass production increased and subsequently diminished. The study area was near Dubois, Wyoming, at 9,500 ft elevation with annual precipitation of 20 inches. Treatment consisted of spraying plots with 2,4-D in water at a rate of about 3 lb acid equivalent/acre. Gravimetric and neutron probe measurements were taken to determine soil moisture content. About 90% of the sagebrush plants on treated plots were killed by spraying. Net effect of the treatments was to depress total production below control plot levels. Spraying big sagebrush reduced the rate of soil moisture withdrawal. 75% of the difference in total moisture depletion occured within the 3-6 ft soil depth. An opposite effect in the second foot indicated that the increase in grass herbage production was most strongly reflected in that zone. Total evapotranspiration losses from the 0-6 ft soil profile were reduced about 14% over the 4-month growing period the second year after spraying. Big sagebrush grows in arid climates where the principles of the study could be applied. (Blecker-Ariz)
W69-00379

WATER ENTRY, WATER USE AND SEASONAL-MOISTURE REGIMES IN FLOOD-IRRIGATED RIVERINA SOILS,
Australia CSIRO, Div. of Soils.
J. Loveday, and D. R. Scotter.
Australian J Exp Agr and Anim Husb, Vol 6, pp 296-304, August 1966. 9 p, 5 fig, 7 tab.

Descriptors: Soil physical properties, Flood irrigation, Soil moisture meters, *Infiltration, *Soil water, *Water balance, *Fertilizers, Irrigation practices, Bouyoucos blocks, Crop production, Moisture content, Sampling.
Identifiers: New South Wales, Australia, Seasonal moisture regimes.

An experiment was conducted in New South Wales, Australia to determine the amount of water used by irrigated winter pasture species and the water potentials of the soils supporting vegetation. The assessment of the soil water regimes were made by both the water balance and matric potential methods. Four types of treatments were made on 14 sites. Treatments consisted of normal fertilizer and normal irrigation, extra fertilizer and normal irrigation, normal fertilizer and frequent irrigation, and extra fertilizer and frequent irrigation. The matric potential, water use, and yield data suggested that soil water was below optimum for part of the growing season on most of the soils with the normal irrigation schedule. It was concluded that water entry characteristics largely covered the yield. (Affleck-Ariz)
W69-00382

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on THE Surface

WATER SUPPLY FORECASTS FOR THE NORTHEASTERN UNITED STATES.
Weather Bureau, River Forecast Center, ESSA, Hartford, Conn.

Yearly ESSA publications on January 1, February 1, March 1, and April 1. Vol. 10 No. 1-4, Jan-April, 1968.

Descriptors: Water supply, *Streamflow, Northeast U. S., Seasonal.
Identifiers: *Forecasts.

These bulletins present ESSA Weather Bureau forecasts of total seasonal streamflow (November through May) to be expected from numerous

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watersheds in Maine, New Hampshire, and New York. The success of these forecasts is largely due to the time lag between winter precipitation and spring runoff, and to the lack of runoff produced by summertime precipitation. Forecasts are based on flow to date, precipitation to date and information on the snowpack at higher elevations. They are issued on the first of each month, January through April of each year. Five levels of possible flow or forecasts are given depending upon whether precipitation yet to fall through May 31st is equal to the minimum of record, the lower quartile, average precipitation, upper quartile, or the maximum of record. Forecasts in tabular form are summarized in narrative statements made for major basin drainages. (Strahl-ESSA)
W69-00002

STEVENS V SPRING VALLEY WATER WORKS AND SUPPLY CO (DAMAGES TO STREAM FLOW BY PUMPING).

42 Misc 2d 86, 247 N Y S 2d 503-512 (1964).

Descriptors: *Judicial decisions, *New York, Real property, Riparian rights, Pumping, *Perennial streams, Percolating water, *Damages, Water supply, Wells, Surface-ground water relationships, Obstruction to flow, *Water sources, Ground water.

An award for damage to plaintiff's real property allegedly caused by defendant's interference with the source of a perennial stream was affirmed by the New York Supreme Court Appellate Term. The court held that testimony of plaintiff's expert witness and admissions of defendant's chief engineer and a ground water geologist who testified for defendant as an expert presented a jury question whether there was any correlation between the pumping of defendant's well and the lowering of the water table in another well and the drying up of a stream. A riparian owner's right to a natural stream flow proects him from diversion and diminution of a stream caused by arresting and collecting underground waters which percolate through the Earth to feed the stream, according to New York case law cited as authority for the decision. (MacMillan-Fla)
W69-00006

CHAPPELL V WINSLOW (DIVERSION OF SURFACE WATER).
State of North Carolina.

258 N C 617; 129 S E 2d 101-107 (1963).

Descriptors: Drains, Ditches, Surface drainage, *Diversion, *Natural flow doctrine, *Surface runoff, Surface waters, Drainage water, Discharge (Water), Judicial decisions, North Carolina.

Lower land owners sought an injunction to stop upper land owners from accumulating, then discharging surface waters onto their lands. The trial court granted the injunction and the Supreme Court of North Carolina affirmed. Upper land owners have an easement, which requires lower owners to receive waters from the upper tract which flow naturally therefrom. The upper land owner may even increase and accelerate the flow. But he cannot divert the surface water so as to cause it to flow on lower land in a different manner and place. Following this rationale the trial judge decided that the defendants were not entitled to drain into a highway ditch surface water from ditches spaced about 250 feet apart. Such drainage would amount to a diversion of water from its natural flow, causing plaintiffs injury for which they had no adequate remedy at law. Plaintiffs were thus entitled to the injunction granted. (Harriett-Fla)
W69-00020

STATE ROADS COMM'N V PRESTON (DRAINAGE EASEMENTS).
226 Md 443; 174 A 2d 61-66 (1961)

Descriptors: *Easements, Legal aspects, Surface runoff, Drainage systems, Ditches, Channeling, *Drainage, *Water, Judicial decision, Maryland.

The state acquired in 1954, by deed, strips of land adjacent to a roadway. Also acquired was a right to maintain on or across part of the grantor's land waterway necessary for drainage. The part of the grantor's land subject to the drainage easement was clearly marked on the plats. When the state widened the road in 1955, the additional surface runoff caused by the widening was directed by ditches and pipes onto grantor's lands, causing considerable erosion. The section of the grantor's land where the water and accumulated debris were dumped had not been marked on the plats. The grantors' obtained an injunction to stop the flow of water upon their land. The injunction was upheld on appeal, because the deed did not convey a drainage easement over all of the grantors' adjacent property, but over only those portions marked on the plats. (Harriett-Fla)
W69-00024

HOLMES V STATE (FLOODING BY DRAINAGE INTERFERENCE).
32 Misc 2d 1077; 226 N Y S 2d 626-631 (1962).

Descriptors: *New York, Surface runoff, *Drainage water, Drainage, *Water law, Judicial decisions, Riddance (Legal aspects), *Damages.

Plaintiff brought an action for damages against the State of New York for flooding of the basement of his house caused by the construction of a highway bridge approach. The State defended the action on the ground that the design of the offending structure was in accordance with good engineering practive. The court, in holding for the plaintiff, stated that the fact that the design was in accordance with good engineering practice was not sufficient to remove liability of the State if its acts were in derogation of the rights of the claimant. As to the plaintiff's rights, the court said that a lower property owner (the state here) has a right to improve his property provided that the improvements are made in good faith and that the water is not collected and drained into the property. The court on the facts found that the defendant had gone beyond what it might do as a lower property owner without incurring liability. However, recovery was limited to injuries sustained up to the time of filing the claim. (Patterson-Fla)
W69-00032

WITHERS V BEREA COLLEGE (WITHHOLDING DRAINAGE WATERS NOT ACTIONABLE).
349 S W 2d 357-359 (Ky 1961).

Descriptors: *Kentucky, *Watercourses (Legal), *Surface runoff, *Drainage water, Drainage, Water law, Judicial decisions.

The case involves an action for damages and an injunction against the defendant Berea College for wrongfully causing a creek, as it passed through the land of the plaintiffs, to go dry during the summer months. The defendant had constructed a dam across a hollow and had impounded water in this area. The trial court held for the defendant on the theory that prior to the construction of the dam, the creek did not exist as a watercourse above the dam site. The court in the instant case agreed. It stated that although it is difficult to determine factually at what point water ceases to be surface drainage and becomes a natural watercourse, the law as to surface water is clear. At common law and Kentucky statute, the owner of land may collect and use as he pleases surface water that has not entered into a natural stream or definite waterbody. The court also stated that surface drainage becomes a natural watercourse where it begins to form a channel with a bed and banks, or sides and current, although the stream may be small and the flow intermittent. (Patterson-Fla)
W69-00034

E J HOLLINGSWORTH CO V JARDEL CO (SURFACE DRAINAGE).
178 A 2d 307-310 (Del 1962).

Descriptors: Watercourses (Legal), Storm drains, Drainage, Ditches, *Surface drainage, *Paving, Pipes, *Easements, Rain water, Surface runoff, Land development, Water law, Overflow, Flood damage, Rain, *Storm runoff, Drainage systems, Delaware.

Plaintiff brought this action to enjoin the defendant from collecting and dumping its surface water by means of a storm sewer into a pipe on plaintiff's land which in turn empties into a ditch running across plaintiff's property. Plaintiff's lands have served for innumerable years as the natural drainage area for the surface water of much of the surrounding land, including most of defendant's property. The court concluded that there had been created in defendant's favor a drainage easement across plaintiff's property. The issue was as to the defendant's rights in such easement. The defendant proposes to blacktop an area of about 27 acres. Only two-tenths of the water falling on defendant's land from any storm now flows off the ground. After the paving is completed nine-tenths will flow off. The court held that the extent of the burden which defendant will place on the easement is so great that plaintiff is entitled to a permanent injunction prohibiting defendant from permitting surface water from flowing into plaintiff's drainage pipe. (R. Smith-Fla)
W69-00038

WINTERSTEIN V DIETRICH (NEW DRAINS WHERE OLD DRAINS EXIST).
369 Mich 415 120 N W 2d 254-258 (1963).

Descriptors: Michigan, Judicial decisions, Farms, Ditches, Drainage, *Assessments, Subsurface drains, Drainage programs, Drainage districts, Administrative decisions.

This case concerned the construction of a new drain over an older, yet servicable, drain. The issue was whether or not an adjoining landowner of the old drain could be fully assessed for the new drain where the old drain fully met his needs. It was held that he would be liable only for the actual gain to him. The new drain was to be underground while the old drain was an open ditch designed for farm drainage. Since the landowner here was a farmer, his liability was limited by that use. (Crabtree-Fla)
W69-00041

PRICE V EMPIRE LAND CO (LAND DRAINAGE).
218 Ga 80; 126 S E 2d 626-630 (1962).

Descriptors: Surface waters, Surface drainage, *Diversion, Natural flow doctrine, *Discharge (Water), *Flumes, *Sumps, Diversion structures, Judicial decisions, Georgia, Surface runoff, Ditches, Drainage systems, Damages, Erosion.

The litigants owned adjoining lands. The defendants connected all surface drainage by a system of ditches, causing all waters to concentrate in three large sumps. The water from the sumps was discharged into a concrete flume which sloped to the plaintiff's property line. Plaintiff contended that this construction by the defendant caused the waters to enter plaintiff's lands with greater force than the natural flow, resulting in erosion damage to plaintiff's property. The trial court refused to grant an interlocutory injunction. The Supreme Court of Georgia acknowledged that there was evidence of damage to plaintiff's land, but decided no abuse of discretion resulted from the trial courts refusal to grant the interlocutory injunction. Plaintiff did not show that an injunction was necessary to protect the plaintiff's interest during pendency of the suit. (Harriett-Fla)
W69-00042

BRAUN V FOXBORO CO (DISCHARGE OF SURFACE WATERS).
193 N E 2d 680-681 (Mass 1963).

Descriptors: *Judicial decisions, *Massachusetts, Water law, Legal aspects, *Surface drainage, *Surface runoff, Conduits, Reasonable use.
Identifiers: Injunction.

Plaintiff lower landowners sought to enjoin defendant upper landowners from discharging surface and contaminated water onto the lower land. The defendants had enclosed a brook which ran through their land in an eighteen inch pipe and connected it to a culvert installed under a road abutting on plaintiff's land. The natural drainage was from the defendant's land to plaintiff's land anyway. The facts as established in a master's report showed that the periodic increases in the flow of surface water were not attributable to the defendant and that it did not contaminate such waters. Also, only seventeen percent of the average flow in the drainage system was a result of the defendant's plant operation. The court held that this was a reasonable use and the lower court was correct in dismissing plaintiff's bill seeking injunctive relief. (R. F. Williams-Fla)
W69-00063

GRAVES V WIMPY (COMMUNITY DRAINAGE DITCHES).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00068

WILLIS V RICH (OBSTRUCTION OF DRAINAGE EASEMENT).

30 111 2d 323, 196 N E 2d 676-680 (1964).

Descriptors: *Judicial decisions, *Illinois, Remedies, *Easements, Surface runoff, Surface drainage, Drainage systems, Drainage water, Surface waters, Drains, *Tiles, Prescriptive rights.
Identifiers: *Injunctions.

Plaintiff, owner of a dominant estate, brought an action for a mandatory injunction to compel defendant to restore a mutual drain line across defendant's servient estate to its original condition. Defendant had built a retainer wall in the natural watercourse and diverted the flow into a 15 inch tile line which was inadequate to handle the flow of water. Flooding of plaintiff's property resulted. The trial court dismissed the suit for want of equity. On appeal to the Illinois Supreme Court, held, reversed. Plaintiff had repeatedly demanded the removal of the substituted drain system. Plaintiff had a drainage easement across defendant's land prior to the obstruction and such obstruction by the defendant will ripen into an easement itself unless the mandatory injunction is granted. (R. F. Williams-Fla)
W69-00069

KIDWELL V BAY SHORE DEVELOPMENT CORPORATION (OBSTRUCTION TO FLOW TO SURFACE WATERS).

232 Md 577 194 A 2d 809-814 (1963).

Descriptors: Judicial decisions, Maryland, *Obstruction to flow, *Prescriptive rights, Civil law, *Natural flow doctrine, Reasonable use, Damages, Highways, *Landfills, Zoning.
Identifiers: *Servitudes.

Plaintiff was a motel owner whose property adjoined a landfill owned by defendant and filled after plaintiff's motel was built. Ocean City was a third-party defendant joined because a highway bordered plaintiff's land and because Ocean City permitted the landfill operation. When plaintiff built the motel, his land was not in Ocean City. The landfill operation obstructed the normal flow of surface water from plaintiff's land. The court held, that while Maryland is a Civil Law state as to surface waters, reasonable use could be applied for equitable reasons. Here, plaintiff secured partial relief and defendant was not held strictly liable for all damage caused. (Crabtree-Fla)
W69-00072

MILLER V SOMMERS (OBSTRUCTION TO SURFACE DRAINAGE).

11 Ches Co Rep 144-150 (1963).

Descriptors: Water law, Legal aspects, *Pennsylvania, *Judicial decisions, Surface runoff, *Surface drainage, *Reasonable use.
Identifiers: Upper owner, Lower owner, Restatement of Torts.

Plaintiff, upper landowner, averred that defendant, an adjoining lower landowner, had constructed a wall that blocked the drainage of surface water from plaintiff's land, causing flooding of his cellar. On these alleged facts, the defendant's demurrer was held properly overruled. Pennsylvania follows Sec 833 of the Restatement of Torts. Neither an upper or lower owner may divert or block the flow of surface water, willfully or negligently, so as to unreasonably interfere with the use and enjoyment of his neighbor's property. (R. F. Williams-Fla)
W69-00073

PURNELL V HOCK (OBSTRUCTION TO FLOW BY LOWER OWNER).

76 York 197-202 (Pa Com Pl 1963).

Descriptors: Pennsylvania, Judicial decisions, *Natural flow doctrine, Relative rights, *Obstruction to flow, Floods, Riparian land, Riparian waters, Permits, *Boundaries (Property).
Identifiers: Boundary walls, *Act of God.

The defendant erected a boundary wall on both sides of a stream and artificially built up their land by adding soil. The effect of these improvements during a severe storm was to cause water to flood plaintiff's land. Defendant claimed that since such floods occur only every 10 years, the floods should be treated as Acts of God. This contention was denied and defendant lower riparian owner was made to remove obstructions harmful to plaintiff. (Crabtree-Fla)
W69-00074

BELLVILLE V PORTER (ACCRETION AS IT RELATES TO MAINTENANCE).

130 N W 2d 426-431 (Iowa 1964).

Descriptors: Iowa, Judicial decisions, Ditches, Drainage, Riparian rights, Obstruction to flow, *Accretion (Legal aspects), Prescriptive rights, *Dikes, *Maintenance, Maintenance costs, Natural flow.
Identifiers: *Sloughes.

This case involves two watercourses, one being a ditch and the other a slough. Plaintiffs contend overflow water from the ditch flows through the slough onto defendant's property, and defendant's removal of a dike across said slough caused interference with the flow of the ditch. Plaintiffs asked further relief for maintenance of the ditch and slough. It was held that the dike did not substantially interfere with the ditch flow, and that common riparian landowners have a duty to maintain the ditch because it is a natural watercourse. (Crabtree-Fla)
W69-00077

WAGNER V TIDEWATER OIL CO (DAMAGE RESULTING FROM STREAM FLOW ALTERATION).

191 A 2d 326-330 (Del 1963).

Descriptors: Delaware, Judicial decisions, *Alteration of flow, Dikes, Riparian rights, Natural flow, Relative rights, *Obstruction to flow, *Embankmants, *Tidal effects, Flood damage, Repulsion (Legal aspects), Streams.

A lower riparian owner was legally answerable to the adjoining upper owner for the increase in the amount of water which found its way onto the upper owner's land as a consequence of the diversion of a creek and the alternation of its physical characteristics caused by his action to improve his own land through erection of restraining dikes composed of soft mud. It was found that employees of the lower owner were aware of the character of the mud and should have anticipated the consequence of alteration of the normal course of the stream, casting significantly increased amounts of water on the land of the upper owner. (Crabtree-Fla)
W69-00080

ALLEN V ATLANTA (SURFACE DRAINAGE).
219 Ga 65; 131 S E 2d 549-551 (1963).

Descriptors: Drainage, Surface drainage, Paving, *Ponding, Drainage systems, *Sewers, Surface waters, Storm runoff, Rain water, Water law, Drainage water, Storm drains, Natural flow, Georgia.

The plaintiffs alleged that the defendant by its negligent construction and maintenance of its drainage system was discharging large amounts of surface water upon the lands of the plaintiffs; that a change in the natural flow of the surface water had been caused solely by the city in installing certain paving and curb lines; and that as a result, whenever it rains extensive damage has been occasioned by the flow of waters and by the consequent ponding of waters after the rains subside. Although the plaintiffs proved some of the allegations of their petition without any rebuttal testimony being offered, there was a conflict as to a material issue of the case, that is: upon whom did the responsibility for the unquestioned water damage to the lands of the plaintiffs rest. The defendant claimed the damage was a result of a faulty or clogged drainage sewer maintained by the City of Decatur. On the basis of this conflicting evidence the court affirmed the decision of the trial judge denying the plaintiffs prayers for an interlocutory injunction. (R. Smith-Fla)
W69-00083

FLOODS IN THE AREA OF VEGA ALTA AND VEGA BAJA, PUERTO RICO,
U. S. Geological Survey, Water Resources Division, Washington, D. C.
I. J. Hickenlooper.
U. S. Geol Surv Hydrol Invest Atlas HA-289, 1 sheet, 1968. text, map (scale 1:20,000), 2 fig, 1 tab, no ref.

Descriptors: *Flood, *Puerto Rico, Watersheds (Basins), Forecasting, Spoil banks, Flood plains.
Identifiers: *Vega Alta and Vega Baja, *Hydrological atlas, *Flood occurrence, Drainage basin.

Flooding from Rio Cibuco and its tributary, Rio Indio, is reported and illustrated by USGS Hydrological Atlas HA-289 (scale 1:20,000). A base map shows the topography (contour intervals 5 and 10 m) and displays: the boundary of the 1965 flood; area flooded December 11, 1965; and spoil banks placed during 1966 and 1953-58. Most of the area flooded by Rio Cibuco is planted in sugarcane or used as pasture. In 1966 a drainage canal was constructed from the urban area (flooded in 1965) to the Rio Cibuco channel. The December 11, 1965 flood on Rio Cibuco was the highest known, reaching an elevation of 5.6 m at Central San Vicente. It is estimated that floods will reach stages of 5.6 and 5.5 m at Central San Vicente on the average of once every 68 and 34 years, respectively. The flood profile base lines were drawn to conform with the general direction of the 1965 flood flow. Maximum depth of flooding can be estimated

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from any point shown in the inundated area on the map. Water surface contours can also be determined by levels from a bench mark. (Llaverias-USGS)
W69-00100

CAPE FEAR RIVER BASIN, NORTH CAROLINA; INTERIM REPORT ON RANDLEMAN AND HOWARDS MILL PROJECTS.
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 343, 233 p, 1968. 4 fig, 1 plate, 18 tab, 37 ref, 5 attach, 2 append.

Descriptors: *Water supply, *Recreation facilities, *Floods, *Flood control, *River basin development, North Carolina, Water quality, Cost-benefit analysis, Municipal water.
Identifiers: Cape Fear River Basin, N C, Deep River Basin, N C.

The flooding, public water supply and recreational potential of the Cape Fear River basin, North Carolina, were investigated and a plan for basin-wide development of water resources is presented. The area includes the cities of Greensboro, High Point, and Burlington. The Randleman and Howards Mill dam construction projects in the Deep River Basin would provide for present and future needs, substantially supplementing the New Hope project, which is under construction. The projects would: increase the prevention of annual flood damages from 59% to 83%, provide 27,000 acre-ft of storage for water supply, provide 25,000 acre-ft of storage for water quality control, and provide excellent recreational facilities for an estimated 2,867,000 persons. First cost is estimated to be $26,320,000 with annual cost of $288,000. Annual benefits are $2,115,000 with a benefit-cost ratio of 1.7 to 1. Data on the economics, population, hydrology, water quality, power needs, and municipal water needs of the area are tabulated. (Knapp-USGS)
W69-00117

FLOOD PROFILE STUDY, SQUAW CREEK, LINN COUNTY, IOWA.
U. S. Geological Survey.

U S Geol Surv open-file rep, June, 1968. 13 p, 4 fig, 4 plate, 1 tab, 2 ref.

Descriptors: *Floods, *Flow profiles, *Flood protection, *Hydrologic data, Backwater, Floodways, Iowa, Watershed management.
Identifiers: Flood profiles, Cedar Rapids, Iowa.

Flood-inundation limits for a flood of 8,000 cfs under present channel and valley conditions are shown on maps scaled about 1 in. to 200 ft for an 18,000 ft reach of Squaw Creek, a tributary of Cedar River in Cedar Rapids, Iowa. Water surface profiles are also presented graphically for the 8,000 cfs flood and for a 5,600 cfs flood under 2 different assumed degrees of channel encroachment. Mean velocities for selected conditions at many sites are given in a table. The information presented is of particular value for planning agencies and groups involved in flood plain management. (Knapp-USGS)
W69-00129

LABORATORY AND FIELD TESTS OF POND SEALING BY CHEMICAL TREATMENT,
Tennessee Univ., Knoxville, Dept. of Agricultural Engineering.
John I. Sewell.
OWRR Project No. A-003-Tenn., Agricultural Experiment Station Bulletin 437, March, 1968. 14 p, 4 fig, 5 tab, 4 ref.

Descriptors: *Seepage, *Permeability, *Reservoir leakage, *Reservoirs, *Darcy's law, Lagoons, Ponds, Farm ponds, Water holes.
Identifiers: *Pond sealing.

Over 500 permeability tests with 8 soil-dispersing chemicals were conducted on 9 Tenn. soil types. Sodium pyrophosphate treatments at 2 and sodium carbonate (soda ash) at 5 tons per acre were the most successful. These treatments costing approximately $375 per acre for chemicals reduced the permeability of the 9 soils to from 1/10 to 1/100 of the permeability of identical but untreated samples. Laboratory test results suggest that at least 1 ft. of well compacted relatively impervious seal blanket over porous areas of pond floors is necessary to prevent rupture of the seal blanket under 10-ft. heads. 9 seriously leaking ponds were treated according to the best procedures developed in the laboratory. 8 of these treated ponds held well; and between Jan. 1 and Nov. 15, 1967, the mean ratio of minimum to maximum pond depths was 0.74. 1 pond developed serious leaks which were successfully repaired to a pond depth of 6 ft. The field tests substantiated the laboratory tests in that chemical treatments can, for certain situations, be effective in reducing reservoir seepage. (Author)
W69-00224

BIG SIOUX RIVER, IOWA AND SOUTH DAKOTA.
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, Senate Doc No 94, 73 p, 1968. 5 tab, 1 attach, 2 append.

Descriptors: *Flood control, *Channel improvement, *Iowa, *South Dakota, Missouri River.
Identifiers: Big Sioux River, Iowa, Sioux City, Iowa.

Flooding of the Big Sioux River, a left bank tributary joining the Missouri River just upstream from Sioux City, is described and a plan for flood control is presented. The Big Sioux River drains 9,565 sq miles in 3 states. The basin is used almost entirely for agriculture. The lower 5.5 miles of the river traverses a suburban residential area and presents a serious flooding and erosion problem. Annual flood damages are $103,100 and are expected to reach $174,900 with no control. A feasible plan includes channel straightening and widening, a cutoff at the lower end, and riprap at concave bends and bridge abutments. The cost is $2,910,000, and the benefit-cost ratio is 1.3 to 1. There are some recreational benefits. (Knapp-USGS)
W69-00235

TANANA RIVER BASIN AT FAIRBANKS, ALASKA (FLOOD CONTROL PROPOSAL).
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, Senate Doc No 89, 96 p, 1968. 1 plate, 4 photo, 1 suppl, 1 append.

Descriptors: *Flood control, *Recreation facilities, *Dams, *Levees, *Reservoirs, Cost-benefit analysis, Alaska, Floods, Flood damage.
Identifiers: Tanana River, Alaska, Chena River, Fairbanks.

Flooding in Fairbanks, Alaska, in the Tanana River Basin, is described and a proposal for flood control is presented. The 0est solution to the flood problem is a dam and reservoir on the main Chena River, a dam and detention reservoir on the Little Chena River, a levee on the tanana River, and a pumping plan0 in Fairbanks. The estimated first cost is $113,000,000 of which $111,000,000 is Federal and $2,000,000 is non-Federal. The annual cost is $261,000, and benefit-cost ratio is 2.7 to 1. The estimated annual recreational benefits are $250,000. (Knapp-USGS)
W69-00243

ALHAMBRA CREEK, CALIFORNIA (FLOOD CONTROL PROPOSAL).
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 336, 116 p, 1968. 1 fig, 2 plate, 2 photo, 1 attach, 3 append.

Descriptors: *Flood control, *Channel improvement, *Diversion, *California, Cost-benefit ratio, Floods, Flood damage.
Identifiers: Alhambra Creek, California, Martinez, California.

Flooding of Alhambra Creek, Martinez, California, was investigated and a plan for flood control is presented. Martinez is about 25 miles east of San Francisco. The drainage basin is about 5 miles long, averages 3.5 miles wide and has an area of about 16.5 sq mi. A serious flood problem exists; future damages are expected to average $291,000 per yr. Flood control by channel improvement and diversion works is economically feasible. The total cost is $8,900,000 of which $8,000,000 is federal. Annual charges would be $310,000 and benefits are estimated to be $372,000 from reduction of damage, reduction in bank protection expense, and land enhancement; the benefit-cost ratio is 1.2 to 1. (Knapp-USGS)
W69-00244

MARTIN COUNTY, FLORIDA.
Army Corps o Engineers, Jacksonville, Florida.

Army Corps of Eng, Surv-Rev Rep, 35 p, Sept 22, 1967. 1 plate, 3 tab, 1 suppl, 3 append, 1 disc.

Descriptors: *Flood control, *Water resources, *Irrigation water, *Florida, Levees, Canals, Locks, Recreation facilities.
Identifiers: Martin County, Florida.

In response to requests that Martin County be included in the Central and Southern Florida Project, the plans were reviewed and it was found that a primary canal system of 60% standard project flood capacity would be an adequate outlet for the area's flood waters. The proposed plan would eliminate floods up to 30 yr magnitude, reduce stages and durations of larger floods, provide water control, and provide facilities for supplying irrigation water from Lake Okeechobee. The estimated benefit-cost ratio is 15.3 to 1. The total cost is estimated to be $16,220,900. (Knapp-USGS)
W69-00246

WATER RESOURCES FOR CENTRAL AND SOUTHERN FLORIDA.
Army Corps of Engineers, Jacksonville, Florida.

Army Corps of Eng, Surv-Rev Rep, 75 p, Feb 15, 1968. 12 fig, 1 plate, 5 tab, 1 suppl, disc.

Descriptors: *Water resources, *Flood control, *Florida, Levees, Canals, Design flow.
Identifiers: Everglades National Park, Lake Okeechobee.

A restudy of the water supply and flood control project for central Florida, some of which is already constructed, finds that the authorized project will not meet water resource needs of the area after 1976, and presently existing works are part of the cause of a dangerously decreased flow of water into Everglades National Park. The most practicable plan is: (1) Raising Lake Okeechobee about 4 ft above presently authorized levels; (2) Provision of facilities for pumping excess water back into storage in Lake Okeechobee and the water conservation areas; (3) Provision of a system of canals, levees, pumping stations, and control structures for conveyance of water to demand areas; (4) Removal of humps from North New River and Miami Canals; (5) Provision of enough canal capacity at and below Tamiami Trial to permit design discharge at Structure 12; (6) Pumping first from agricultural canals when Lake Okeechobee must be drawn down; (7) Provision of needed recreational facilities. Estimated first cost is $76,918,300, of which $6,617,000 is for recreational facilities. Annual cost is $4,691,700, of which $698,000 is for recreation. The benefit-cost ratio is 2.8. (Knapp-USGS)
W69-00247

FLOODFLOWS FROM SMALL DRAINAGE AREAS IN ILLINOIS: PRELIMINARY FLOOD-FREQUENCY RELATIONS,
U. S. Geological Survey, Champaign, Illinois.
Davis W. Ellis.
U S Geol Surv open-file rep, 10 p, 1968. 6 fig, 4 ref.

Descriptors: *Floods, *Frequency analysis, *Small watersheds, *Illinois, Streamflow forecasting, Hydrographs.
Identifiers: Flood frequencies.

Preliminary techniques are presented for estimating flood-frequency relations, up to the 50-yr recurrence interval, for streams in Illinois that have drainage areas no greater than 10 sq miles. The defined relations will be useful for the design or improvements of highway culverts and other hydraulic structures. Annual flood discharges for 61 stations with 12 yr of record and for 36 stations with 7 yr of record were analyzed with the respect to several basin characteristics. The drainage areas for these 97 stations range from 0.02 to 40 sq miles. Two estimating techniques are presented: One requires determination of only the size of drainage basin and a regional factor; and the other requires the determination of an additional parameter, channel slope. The relative reliability of the 2 techniques is approximated. An example is given to demonstrate a step-by-step procedure of applying the techniques by computing the 25- and 50-yr floods for a site on Crooked Creek in Union County, Illinois. Nomographs relate flood frequency, drainage area, slope, and regional runoff factor. (Knapp-USGS)
W69-00254

SURFACE WATER LAW IN VIRGINIA.
Virginia Univ, Charlottesville.

U Virginia L Rev, Vol 44, No 1, pp 135-150, Jan 1958. 16 p, 82 ref.

Descriptors: Remedies, Runoff, Surface runoff, *Virginia, Local governments, Water law, Civil law, Judicial decisions, Legal aspects, *Repulsion (Legal aspects), *Surface waters, Riddance (Legal aspects), Reasonable use, *Discharge (Water), Obstruction to flow, Relative rights, Diversions, Abatement, Rain water, Snow melt.

Three primary divisions of surface water law are discussed. These are the definition of surface water, the theories applied by the courts in this country, and the Virginia rule and its application. Surface water is defined as water which results from rains or melting snow and is diffused over the surface of the ground, forming no part of a natural stream or watercourse. Under the civil law rule, judicial enforcement of physical law is the key determinative in resolving conflicting interests of abutting property holders. Under the common-law rule, surface water is regarded as a common enemy which every landowner may fight off as best he is able. The reasonable use theory maintains that every landowner has the right to make reasonable use of his land, even though harm is caused to his neighbor. Virginia follows the common enemy concept, modified by the proposition that one must make use of his property so as not to injure the rights of another. The application of the Virginia rule is discussed in detail.
W69-00277

AIRPORTS, SUBDIVISIONS AND SURFACE WATERS,
Cincinnati Univ., Ohio.
James Munro.
U Cin L Rev, Vol 30, No 4, pp 391-417, fall 1961. 27 p, 74 ref.

Descriptors: Surface waters, *Surface runoff, Drainage water, Floods, *Drainage systems, Drainage, Drainage practices, Excess water (Soils), Drainage patterns (Geologic), Damages, *Flood damage, Streams, Channels, Ditches, Surface drainage, *Repulsion (Legal aspects), Ohio.

The law of surface waters in Ohio is discussed. The decision of Mason v Vommissioners of Fulton County is analyzed for its modification of the law of surface waters. The modification per Macon permits an upper proprietor in the exercise of his servitude to cause an increase in flow, providing that the increased flow is placed in channels or watercourses already existing on the premises of the upper proprietor. But the change in an upper proprietor's right of servitude may be more illusary than real. One reason is that the Mason rule only applies to rural lands. The common enemy rule obtains with urban lands. The common enemy rule obtains with urban lands, which permits the lower owner to repel the surface water flowing onto his land. Also, recent decisions from lower Ohio courts undermine the additional protection of Mason. These decisions limit the increase of flow to the capacity of the stream. This new trend places the burden on the man who changes run-off patterns, because he runs the risk of paying damages for overburdening existing channels.
W69-00295

TAXATION OF LANDS COVERED BY NAVIGABLE WATERS USED FOR COMMERCIAL PURPOSES.
State of Florida.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00319

WATER AND SEWER REGULATIONS.
State of Florida, Tallahassee.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00321

PREDICTION MODELS FOR INVESTMENT IN URBAN DRAINAGE SYSTEMS,
Virginia Polytechnic Institute, Water Resources Research Center, Blacksburg.
John W. Knapp, and W. J. Rawls.
OWRR Report A-011-VA, August, 1968. 7 p.

Descriptors: *Drainage systems, *Economic predictions, Investment, *Storm drains, *Cost analysis, Drainage practices, Controlled drainage, Small watersheds, Cost-benefit theory, *Cities.
Identifiers: Prediction models, Urban drainage systems.

Study of data from over 100 small urban drainage systems led to formulation of prediction equations for the cost of conventional storm drainage facilities. Variables studied represented both physical features and design considerations. Regression techniques and factor analysis were used to screen the variables, to verify significance and independence, and to identify design patterns. Multiple regression techniques and principal components analysis were used in selecting and fitting the prediction models. Non-linear models provided the best predictors. One type to estimate total cost included independent variables describing slope, runoff factor, smallest pipe diameter, outlet capacity, and developed area; it can be used as a planning factor before preliminary layout of the system. Another used largest and smallest pipe diameters, developed area, total length of lines, and number of inlets and manholes; it can be used for estimating cost after preliminary design layout. Both types gave correlation coefficients over 0.95 and efficiency ratios over 70%. The models can be manipulated for use in comparative benefit-cost analysis. (Author)
W69-00324

LEGAL DECISIONS INVOLVING WATER AND WASTEWATER,
Leo T. Parker.
Water Works and Wastes Engineering, Vol 2, No 3, pp 63-64, Mar 1965. 2 p.

Descriptors: *Judicial decisions, Water law, Legal aspects, *Cities, *Water pollution, Municipal water, *Water works, Water conveyance, Conduits, Damages.
Identifiers: Damages (Legal aspects).

This article discussed several recent decisions regarding water works. In the first, Gordon v Provo City, 391 Pac 2d 430, it was held that when a city operates a water system as a commercial venture, it is liable for negligence in maintenance and operation (in this case, the placing of a water meter) regardless of whether the water meter is placed on plaintiff's land or in the street. Fields v Kansas City, 377 S W 2d 528, held city liable for injuries sustained by plaintiff when he fell into an uncovered manhole in an unlighted alley. Pieper v City of Scottsbluff, 126 N W 2d 865, held that in an eminent domain proceeding, the actual fair and reasonable market value included the value of gravel beds on the land. Anderson v Boise Water Corp, 372 Pac 2d 752, held officials of the water works negligent for not frequently inspecting an old water main. In conclusion, several cases on nuisance, and the measure of damages therefore are discussed. (Williams-Fla)
W69-00334

DIFFUSED SURFACE WATER: SCOURGE OR BOUNTY,
Frank E. Maloney, and Sheldon J. Plager.
Natural Resources Journal, Vol 8, No 1, pp 72-113, Jan 1968. 42 p, 242 ref.

Descriptors: Reasonable use, Remedies, Consumptive use, Surface drainage, *Diversion, Watercourse, *Surface runoff, *Repulsion (Legal aspects), *Riddance (Legal aspects), Civil law, Nuisance (Water law), Stagnant water, *Obstruction to flow, Riparian rights, Drainage districts, Easements, Judicial decisions, Water transfer, Florida.
Identifiers: Everglades National Park, Green Swamp (Fla), Central and Southern Florida Flood Control District, 1957 Water Resources Law.

Diffused surface water is water from rain, springs, or melting snow which lies or flows on earth's surface but which does not form part of water course or lake. This excludes natural water courses and flood waters connected thereto, lakes, ponds, marshes, swamps, and water artificially brought on property. Under civil-law rule, upper owner has easement over lower owner's land for natural drainage; under common enemy rule lower owner may keep water off land by any means. Reasonable use modification to both rules allows owner to deal with diffuse surface water as he wishes as long as his act is reasonable under all circumstances. Upper owner's liability is discussed for diversion, collection and discharge, raising land level, paving surface and drainage into natural watercourse. Lower owner's liability is considered for damming back water and raising land level. Legal action may be based on trespass, negligence and nuisance. Preferred remedy is injunction. Identification of injury as permanent or temporary determines measure of damages. Defenses are contributory negligence, assumption of risk, statute of limitations and prescriptive rights. Avoidable consequences or comparative negligence rule may reduce recovery. Priority of occupation is defense in some states. (Ausness-Fla)
W69-00337

IOWA'S NEW WATER STATUTE - THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00338

COMPENSABLE VALUES IN FEDERAL 'TALKING' OF DAMSITES.

Stan L Rev, Vol 14, No 4, pp 800-810, July 1962. 11 p, 58 ref.

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Descriptors: Judicial decisions, *Navigable waters, *Damsites, Federal government, Dam construction, *Eminent domain, Water policy, Public benefits, *Riparian land, Water law, Non-navigable waters.
Identifiers: *Navigation servitude, Constitutional law, *Property rights.

The article focuses on the amount of compensation which the fifth amendment requires the federal government to pay for taking privately owned damsite lands. The navigation servitude, which stems from congressional power to regulate interstate commerce, holds that private ownership of property in and along navigable rivers is subservient to the federal interest. This servitude extends to flood control and hydroelectric projects. In United States v Twin City Power Co, the Supreme Court indicated that compensation must be paid for the taking of private property above the mean high-water mark, except for value which is attributable to the 'flow of the stream.' However, when viewed in light of United States v Virginia Elec Power Co, these cases raise questions as to what upland values will be deemed attributable to the flow of the stream. After a careful examination of the two cases, the author concludes that they are not inconsistent on the basis of Hohfeldian analysis. United States v Grand River Dam Authority, which extended the navigation servitude to nonnavigable rivers, is discussed. It is concluded that the social cost of exercising the navigation servitude should not be overlooked. (Patterson-Fla)
W69-00339

SIMULATION TECHNIQUES FOR DESIGN OF WATER-RESOURCE SYSTEMS,
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00342

MANAGEMENT MODELS FOR WATER RESOURCE SYSTEMS,
Cornell Univ, Ithaca, N Y.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00348

A SYSTEMS ANALYSIS OF THE LOWER GANGES-BRAHMAPUTRA BASIN,
Harvard Univ, Cambridge, Mass.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00350

4B. Groundwater Management

THE RELATIONSHIP OF FLOODING AND SALINE WATER TABLES,
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00159

SUMMARY REPORT ON THE GROUNDWATER RESOURCES OF THE ANYANG CHON BASIN,
U S Geological Survey.
J. T. Callahan, S. I. Choi, and J. S. Han.
J Geol Soc of Korea, Vol 4, No 1, pp 1-21, May 1968. 22 p, 2 fig, 4 tab, 7 ref.

Descriptors: *Water resources, *Groundwater, *Hydrogeology, Aquifers, Water quality, Water yield, Discharge (Water).
Identifiers: Korea, Anyang Chon Basin, Pumping tests.

The groundwater resources of the Anyang Chon Basin which includes the industrial cites of Anyang and Yong Dung Po Ku in the Special City of Seoul, Republic of Korea are described. Total groundwater discharge is about 24% of the total average annual rainfall of 1,240 mm. Groundwater in storage in the basin is about 1,400 million metric tons; about 190 million tons in alluvium, 980 million tons in saprolite, and 245 million tons in the crystalline rocks. Alluvial acqifers occupy about 85 sq kilometers in the basin. Bedrock consists of granite, gneiss, schist, quartzite, marble and limestone, ranging in age from Precambrian to Cretaceous. Normally the basin receives 70% of its precipitation during the summer growing season. The aquifers of the basin should yield at least 100 million metric tons of water per yr, a little more than double the pumpage in 1967. Existing pumpage is concentrated in Yong Dung Po and Anyang. To develop more ground water, well fields must be dispersed in other parts of the basin. Although the chemical, physical, and bacteriological quality of the ground water generally is satisfactory, its usefulness is threatened by industrial wastes. Waterborne disease epidemics result from improper construction of wells and the proximity of wells to pit latrines. (Knapp-USGS)
W69-00239

GROUND-WATER RESOURCES OF SAN JACINTO COUNTY, TEXAS,
U S Geological Survey.
W. M. Sandeen.
Texas Water Development Board, Rep 80, 89 p, Aug 1968. 19 fig, 7 tab, 37 ref.

Descriptors: *Groundwater, *Aquifers, *Appraisals, Wells, Hydrologic aspects, Water analysis, Texas.
Identifiers: *San Jacinto County, Jasper aquifer, Evangeline aquifer.

In order to determine the availability of groundwater suitable for public supply, irrigation, and industrial uses in San Jacinto County, southeastern Texas, cooperative research was conducted by the USGS and the Texas Water Development Board. Much undeveloped fresh water was found to extend to depths of 1,600 ft in the county. More than half of the 1.2 mgd withdrawn in 1965 was discharged from flowing wells. About 40,000 acre-ft/yr (or 35 mgd of fresh water) could be pumped from the Jasper and Evangeline aquifers, two of three major hydrologic units. A smaller amount of water is available from sands below 400 ft, and from the Catahoula Sandstone, another hydrologic unit. The chemical quality of groundwater is suitable for most purposes. Some waters contain less than 100 ppm/dissolved solids content. The Evangeline aquifer supplies 70% of the water used; the Jasper aquifer, 25%. Stream base-flow measurements related to rejected discharge should be developed since this recharge now rejected by the outcrop areas is an important future water source. (Llaverias-USGS)
W69-00240

PREDICTING RETURN FLOWS FROM IRRIGATION,
Bureau of Reclamation, U S Department of the Interior, Denver, Colorado, Office of Atmospheric Water Resources.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-00248

ROLE OF GROUND WATER IN TEXAS WATER PLAN,
Texas Water Development Board, Austin.
Richard C. Peckham.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR1, Pap 5874, pp 137-152, Mar 1968. 16 p, 4 fig, 2 tab.

Descriptors: *Water resources, *Groundwater, *Texas, Planning, Irrigation, Aquifers.
Identifiers: Texas Water Plan.

The Texas Water Plan has given extensive attention to the availability of groundwater in aquifers of the state. By the year 2020, approximately 5,400,000 acre-ft of groundwater will be used in meeting the State's water requirements. There are approximately 5,000,000 acre-ft of water available annually from the major aquifers of the State and approximately 365,000,000 acre-ft available from storage in aquifers which receive little or no recharge. (Author)
W69-00250

UNCONFINED AQUIFER CHARACTERISTICS AND WELL FLOW,
Engineering-Science, Inc., Oakland, Calif., and California Univ., Davis.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00251

PROBLEMS IN THE USE OF THE PUBLIC DISTRICT FOR GROUNDWATER MANAGEMENT,
Wisconsin Univ, Madison.
Stephen C. Smith.
Land Econ, Vol 32, No 3, pp 259-269, August 1956. 11 p, 29 ref.

Descriptors: *Groundwater, Legislation, State governments, Saline water intrusion, Overlying proprietor, Groundwater recharge, *Surface-groundwater relationships, *Groundwater mining, Water management (Applied), Water resources development, Coordination, Water districts, Artificial recharge, Water conservation, Pumping, Hydrologic cycle.

Many problems associated with the utilization of groundwater can be alleviated by instituting a program of groundwater management. In initiating such a program it is important that groundwater be considered as a component of the area's total water economy and that interrelationship between groundwater and surface water be considered. The execution of such a program requires the creation of some form of organization. One such form is the public district. The article indicates that the district can play a useful role as a local agency for groundwater management. Its geographic flexibility, intertemporal flexibility, concentration upon a single problem, ability to reflect local interests to obtain program adjustments, and ability to relate project costs to benefits commend the district as a groundwater management agency. On the other hand, if the problem is split into fragments, the district form of management may be used to inject an element of rigidity which will slow the process of social change.
W69-00278

FLORIDA'S GROUND WATER: LEGAL PROBLEMS IN MANAGING A PRECIOUS RESOURCE,
Miami Univ, Miami, Fla.
Frank E. Maloney, and Sheldon J. Plager.
U of Miami L Rev, Vol 21, No 4, pp 751-776, 1967. 25 p, 3 fig, 3 map, 129 ref.

Descriptors: Groundwater, Percolating water, Aquifers, Overdraft, *Saline water intrusion, Surface-groundwater relationships, *Artesian wells, Reasonable use, *Legal aspects, Legislation, Florida, Hydrologic cycle, Underground streams, Remedies.
Identifiers: Floridan aquifer, Biscayne aquifer.

There are four legal categories interrelated hydrologically: watercourses, diffuse surface water, underground streams and percolating groundwater. Groundwater is contained in permeable limestone beds called aquifers. In Florida two main aquifers are Floridan and Biscayne. Both water-table and artesian conditions exist. Groundwater problems are interference, overdraft, and contamination. Interference occurs between wells when cones of depression overlap. Overdraft results from pumping at a greater rate than intake of water from recharge area. Contamination includes pollution of groundwater by industrial, municipal or private wastes and salt water encroachment into aquifer - a serious problem in coastal areas. These are met by well-cupping stature, multipurpose water management districts, establishment of salt-water barrier

lines, and pollution control. Groundwater is divided into underground streams and percolating and is presumed to be percolating unless shown otherwise. Surface water law covers underground streams. Percolating groundwater is covered by two rules. Under common law rule, land owner, without malice or waste, may extract unlimited amounts and use it beyond overlying land despite harmful effects to neighbor. Under reasonable use rule, use is limited to beneficial purposes having reasonable relationship to land.
W69-00280

GROUND-WATER DEVELOPMENT IN DESERT AREAS,
Arizona Univ., Tucson, Dept. of Hydrology and Water Resources.
John W. Harshbarger.
Ground Water, Vol 6, No 5, pp 2-4, Sept-Oct 1968. 3 p.

Descriptors: *Water resources development, Arid lands, *Groundwater mining, *Deserts, *Water management (Applied), Computer programs, *Hydrogeology, Planning, Aquifers.
Identifiers: Sahara, Atacama-Peruvian Desert, Egyptian Desert, North American Desert, West Pakistan.

A summary of the development of ground water in several major deserts of the world during the period of 1958-1968 was given. The deserts included the Sahara, the Egyptian, the Atacama-Peruvian, and the North American deserts. Some basic principles for optimum groundwater management are listed. The Indus Basin of West Pakistan was given as an example of a model of sophisticated water management. It was concluded that physical resources and knowledge were available to develop desert areas, the computer and water systems analysis were available for guidance in water management, but man had to supply the necessary wisdom and judgment. (Affleck-Ariz)
W69-00366

4C. Effects on Water OF Man's Non-Water Activities

BYERS V HAMMAN (WATER DAMAGE TO ADJOINING LAND).
State of Pennsylvania, Harrisburg.

46 Westmoreland 213-218 (Pa Com Pl 1964).

Descriptors: Judicial decisions, *Pennsylvania, Spillways, Real property, Marshes, Water level fluctuations.
Identifiers: Equity.

A complaint was filed in equity in the Court of Common Pleas of Westmoreland County, Pennsylvania, charging that the construction of a spillway on defendant's land adjoining plaintiff's property had caused a marshy condition. Defendant answered by denying the alleged facts and raising affirmative defense of laches. Upon hearing, the court dismissed the complaint by decree nisi because the plaintiff failed to prove by clear and convincing evidence that any activities upon part of defendant or her predecessors in title were the cause of the condition complained of. The court deemed it unnecessary to rule on the question of laches, the plaintiff having failed to prove a cause of action. (MacMillan-Fla)
W69-00004

LAMB V DADE COUNTY (LOWER RIPARIAN RIGHTS V UPPER RIPARIAN RIGHTS).

159 So 2d 477-480 (DCA Fla 1964).

Descriptors: *Riparian rights, *Dams, *Drainage systems, Saline water systems, Drainage districts, *Reasonable use, Natural flow doctrine, Riparian land, *Obstruction to flow, Barriers, Relative rights.

Defendant corporation owned, and paid taxes on, a portion of a canal used by plaintiff for primary drainage and water control. Defendant claimed exclusive rights to its portion of the canal and constructed a dam that materially altered the flow. Defendant wanted plaintiff to remove a dam built 17 years before to control salinity. The Court held that proprietor below has the right to receive from the proprietor above the usual flow of water substantially undiminished in quantity, and that the uppre proprietor has no right to unreasonably interrupt or obstruct the natural flow of water to the injury of the lower proprietor. It was established that defendant built the dam only to force plaintiff to remove the lower dam. This was held to be unreasonable. Plaintiff was given the right to maintain the canal within defendant's riparian land. (Crabtree-Fla)
W69-00011

GAZIN V GLADWIN (OBSTRUCTION OF AN UNDEFINED WATERCOURSE).
220 N Y S 2d 861-865 (1961).

Descriptors: New York, Judicial decisions, Damages, *Watercourses (Legal), Streams, *Obstruction to flow, *Landscaping, Landfills, Natural flow, Boundary disputes.

This was an action for damages resulting from the diversion and obstruction of a watercourse. Plaintiffs claimed that defendants raised the level of their land so as to obstruct the natural drainage from plaintiffs land. Plaintiff claimed that artificial drainage was made necessary by this obstruction. The issue was whether the water in question was a defined watercourse, such being a stream with a defined bed, bank, and sides and having a permanent source of supply. A defined watercourse may not be obstructed without raising liability for damages, but in the absence of a defined watercourse, no such liability exists. The evidence supported a finding that there was no defined waterourse and defendants had judgment on that issue. (Crabtree-Fla)
W69-00019

TAYLOR V CONTI (NATURAL FLOW).
149 Conn 174; 177 A 2d 670-673 (1962).

Descriptors: *Natural flow, *Surface water, Connecticut, Erosion, Flood damage, Damages, Running waters, Dams, Land development, Water law, *Silting, Slopes, Washouts, Natural streams, *Flow augmentation, Soil erosion, Farm pond.

The plaintiffs own land with a house and barn erected thereon. In 1956, they completed the construction of a dam to form a pond for swimming and fishing in the waters of a brook crossing their property. In 1957 defendant purchased 73 acres of land for the purpose of subdividing it into building lots. This land was across the street and at a higher elevation than the plaintiff's property. The defendant had DeFelice cut down the hilly areas on the land, remove large quantities of topsoil and fill, and grade, reloam and reseed the land. The defendant's land, denuded of topsoil and with its grade changed to slope toward, rather than away from the street, eroded rapidly. Silt and gravel were washed across the street into the brook and were carried to the plaintiffs' pond. They were also washed onto the floor of the plaintiffs' barn. The trial court awarded the plaintiffs $11,000.00 damages and enjoined defendant from diverting and increasing the flow of surface waters from his land onto the land of the plaintiffs. The court affirmed the holding of the trial court. (R. Smith-Fla)
W69-00023

EPPLING V SEUNTJENS (OBSTRUCTION OF NATURAL FLOW).
117 N W 2d 820-825 (Iowa 1962).

Descriptors: Streams, *Streamflow, Meanders, Alteration of flow, Natural flow, *Ditches, *Dikes, Damages, Flood damages, *Obstruction to flow, Iowa, Judicial decisions.

Through plaintiff's land ran a stream which also ran through the defendant's adjoining land before reaching the river. This course of the stream on defendant's property had been changed prior to plaintiff's purchase of his property. An agreement between defendant and plaintiff's predecessor in title permitted defendant to construct a ditch and dike to channel the waters rather than let the stream spread out over defendant's fields in its natural course. This agreement reserved to plaintiff all remedies against defendant for obstructing the natural flow of surface water to plaintiff's damage. Plaintiff sought redress for damages to his crops and pastures, claiming that the construction of the ditch and dike and the placing of an obstruction in the ditch impeded the natural flow of surface waters. The trial court granted plaintiff the damages. The Supreme Court of Iowa reversed on the following grounds: (1) Defendant could turn the water that came onto his land from plaintiffs in any manner as long as he did not cast it upon plaintiff's land. (2) Plaintiff's allegations of defendant's obstructing the ditch was not supported by the evidence. (Harriett-Fla)
W69-00025

CONRAD V WHITNEY (LANDFILLS ACROSS NON-NAVIGABLE WATERS).
141 So 2d 796-799 (Fla 1962)

Descriptors: *Florida, Judicial decisions, *Landfills, Non-navigable waters, Planning, Road banks, Riparian rights, Recreation, Ownership of beds, *Bayou, Public rights, Right-of-way.
Identifiers: Injunction.

This was a suit for a mandatory injunction to require defendants to remove a fill which they had placed across a natural non-navigable bayou upon which and under which both plaintiffs and defendants owned lands. The original owner of the lands in question subdivided same and platted streets, lots, and a waterway. The plat was not followed and when defendant's attempted to use the plat as reason for their filling operation, the court denied this reason and held that all riparian owners had common rights to the use of the bayou, and the fill must be removed. (Crabtree-Fla)
W69-00029

RECTOR V TOBIN CONSTR CO (HIGHWAY CONSTRUCTION AND FLOODING).

351 S W 2d 816-823 (Mo 1961).

Descriptors: Missouri, Judicial decision, Crops, Damage, Highways, *Landfill, Rivers, *Obstruction to flow, *Flood damage, Flooding, Right-of-way, State governments.
Identifiers: Crop damage, Trespass.

This was an action for crop damage from flooding caused by the defendant contractor's dirt fill placed across a river bed in connection with highway construction. Defendant was liable in that state, sovereignty did not immunize him because the fill was not called for by contract, nor directed by the highway commission, or paid for by the commission. While there was a statute providing double damages where a person stops a watercourse without court permission, it was held applicable only to permanent obstructions and not to the case here of a temporary landfill. (Crabtree-Fla)
W69-00043

ST ANDREWS CHURCH V TOWNSHIP OF LOWER PROVIDENCE (ACCELERATED SURFACE DRAINAGE).

414 Pa 40, 198 A 2d 860-863 (1964).

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Descriptors: *Judicial decisions, *Pennsylvania, *Surface runoff, *Surface drainage, Water law, Legal aspects, Alteration of flow, Conduits, Cities.

The defendant township caused a roadway to be raised approximately 8 inches, thereby blocking the natural flow of surface water and causing accumulations of water to collect upon co-defendant's property. To alleviate this condition, the township installed a concrete drainage pipe under the roadway, causing the surface water which had previously flowed upon plaintiff's property (on the lower side of the road) in a diffused state to become a concentrated discharge of increased quantity. This caused flooding of plaintiff's property and accelerated filling of its cesspool. The court held that the chancellor's award of injunctive relief was proper. Pennsylvania follows the rule that one may not accumulate surface waters in an artificial channel and discharge them upon a lower owner, even if the quantity of discharge is not thereby increased. One justice dissented. (R. F. Williams-Fla)
W69-00044

WILLIAMS V TRUNKLINE GAS CO (RIGHT-OF-WAY).
149 So 2d 160-164 (La 1963).

Descriptors: Land tenure, Water rights, Crop production, Levees, *Flumes, Water conveyance, Bypasses, *Right-of-way, *Rice, Dams, Damages, Louisiana.

Plaintiff granted to defendant a right-of-way to lay, maintain and operate a pipe line across a tract of land owned by plaintiff. The property affected by this right-of-way had previously been leased by plaintiff to Frey for the purpose of farming rice on it. The agreement entered into between plaintiff and defendant provided for certain conditions and for damages for their breach. Frey had planted a rice crop and was flooding it when the construction of the pipe line began. There appears to be an irreconcilable conflict between the testimony of the witnesses and the trial court, apparently accepting the testimony of plaintiffs' witnesses, concluded that defendant had breached its contract with plaintiff by damming up the irrigation canal, by failing to provide for fluming of the water across the right-of-way so that water on the rice fields would remain level, and by failing to build levees along the right-of-way to keep the water from running off the land. The court affirmed the lower courts decision awarding the plaintiff damages. (R. Smith-Fla)
W69-00046

KAPAYANIS V FISHBEIN (STORM RUNOFF).
181 N E 2d 653-654 (Mass 1962).

Descriptors: Drainage, Flooding, *Storm runoff, Rain water, Storm drains, Precipitation (Atmospheric), *Diversion structures, Surface water, Flow, Damages, Channels, *Land development, Water law, Boundaries (Property), Massachusetts.

Plaintiff filed suit to enjoin the defendants from discharging water upon the plaintiffs' land and to obtain damages. Prior to the erection of a house on defendants property the plaintiffs had no trouble with water on their land. After the house was built water came from the roof and flowed onto the plaintiffs land. To alleviate the trouble the defendants constructed gutters with roof drains connected with a series of dry wells. These wells proved inadequate in times of heavy rains. The master found that the condition could be corrected by discharging the water from a gutter at the foot of the slope and connecting it with a street drain below the plaintiffs' land. The plaintiffs had this work done at a cost of $525.00. The trial court enjoined the defendants from permitting water to be collected and to flow on plaintiffs' land and awarded plaintiff $525.00 with interest as damages. The court modified this decree by striking out the provision for injunctive relief. (R. Smith-Fla)
W69-00052

SMITH V ATKINSON (DRAINAGE ENGINEERING).
180 N E 2d 542-544 (Ind 1962).

Descriptors: Surface water, Water law, Flow, Damage, Runoff, Rain, Drainage, *Rainfall-runoff relationships, Runoff coefficient, *Drainage engineering, *Watersheds (Basins), Ditches, Culverts, Land developments, Indiana, Flood damage.

The plaintiffs alleged that they were the owners of Lot 12 in Avalon Hills, and that they had erected certain improvements on Lot 12, one of which was a crushed stone driveway passing over a natural ravine and watercourse. They further alleged that they had provided for the continued drainage in the watercourse by an 18 inch culvert. Defendants, the owners of the higher ground, had improved it by laying out 300 lots and building streets, roads, and drainage ditches. The plaintiff alleged that as a consequence of this improvement the defendants diverted and discharged onto and over plaintiffs property in great quantities the surface water from their land. The defendant claimed that no water waspermitted to flow into the watercourse which did not flow into it before. The court held that the evidence adduced at the trial was conflicting as to the facts material to the issues and thus did not inescapably lead to a result other than that reached by the court. The judgment for the defendant was affirmed. (R. Smith-Fla)
W69-00053

CITY OF NORTHLAKE V CITY OF ELMHURST (PRESCRIPTIVE RIGHTS: DISCHARGE OF SEWAGE).
41 111 App 2d 190, 190 N E 2d 375-381 (1963).

Descriptors: *Juudicial decisions, *Illinois, *Prescriptive rights, Surface drainage, Drains, Surface runoff, Cities, Storm drains, Storm runoff, *Sewage, Sewers, Waste disposal.
Identifiers: *Injunctions.

The City of Northlake brought an action to enjoin the City of Elmhurst from allegedly allowing water and sewage to be discharged upon plaintiff's land. This discharge occurred when the flow in defendant's combined storm and sanitary sewer was too great to be accommodated by the outlet which led to Elmhurst's treatment plant. Defendant contended that it had a prescriptive right to such discharge. The court held that there was evidence that raw sewage was discharged on plaintiff's land and that neither a person nor a municipal corporation could be entitled to throw raw sewage on the lands of another. A permanent injunction was granted against the defendant, and it was directed to remedy the situation. The prescriptive right to discharge storm drainage was recognized. (R.F. Williams-Fla)
W69-00055

DEATON V CAUSEY (SURFACE WATER DRAINAGE - PRESCRIPTIVE PERIOD).

154 So 2d 267-269 (La 1963).

Descriptors: *Louisiana, Surface waters, *Surface drainage, Surface runoff, *Prescriptive rights, Remedies, Damages, Judicial decisions.
Identifiers: *Prescriptive Period, Injunctive relief.

This action for damages and permanent injunctive relief arose as a result of the defendant's alleged excavation and grading of his lot, which caused a constant washing to plaintiff's property by reason of the change in the drainage of the surface water. The trial court held for the defendant on the basis of no cause of action and the running of the prescriptive period. The court in the instant case reversed the trial court. It held that the facts alleged in the case were sufficient, if proved, for injunctive relief to be accorded. The court also held that since the plaintiff alleged that the cause of the damage was more or less continuous and was recognized and acknowledged by the defendant, the prescriptive period would not be deemed to have run. Even though the work was performed in 1926, where the operating cause of an injury is continuous, giving rise to damages from day to day, prescription has no application. (Patterson-Fla)
W69-00056

ASSOCIATED CONTRACTORS STONE CO V PEWEE VALLEY SANITARIUM AND HOSPITAL (LIABILITY FOR ALTERING UNDERGROUND WATERS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00066

DEPARTMENT OF HIGHWAYS V ROUNDTREE (SURFACE WATER DRAINAGE OBSTRUCTION).

372 S W 2d 804-806 (Ky 1963).

Descriptors: Kentucky, Judicial decisions, Surface waters, *Surface drainage, *Obstruction to flow, Natural flow, Drainage, Highways, Easements, *Prescriptive rights, Riparian rights, Relative rights.
Identifiers: Drainage obstruction, *Catch basins.

This was an action by a highway department to enjoin the obstruction of drainage of surface waters from a highway catch basin onto defendant's lower adjoining land, wherein defendant counterclaimed for damages and injunctive relief. Defendant prevailed because he established that the catch basin tapped sources beyond the scope of any natural drainage easement, and that the highway department held no prescriptive right to discharge any additional surface water onto his land. (Crabtree-Fla).
W69-00067

TIEDEMAN V VILLAGE OF MIDDLETON (SURFACE DRAINAGE BY SUBSURFACE DRAINS).

25 Wis 2d 443; 130 N W 2d 783-790 (1964).

Descriptors: Wisconsin, Judicial decisions, *Surface drainage, *Drainage effects, Storm drains, *Prescriptive rights, Surface runoff, *Embankments, Road banks, Cities, Obstruction to flow, Natural flow doctrine, Relative rights.

The evidence in an action to enjoin a city from constructing a storm sewer discharging water on plaintiff's land supported findings that all the water in the drained area would naturally find its way to a pond on plaintiff's land but for a railroad embankment and despite existence of other ponding areas, that water would have reached plaintiff's pond before the embankment was constructed. In that plaintiff had no prescriptive right to embankment and no new watershed was tapped or the water volume increased, defendant city prevailed. (Crabtree-Fla)
W69-00078

HYDROGEOLOGY AT SHELBYVILLE, ILLINOIS - A BASIS FOR WATER RESOURCE PLANNING,
Illinois State Geological Survey.
Keros Cartwright, and Paul Kraatz.
Illinois State Geological Survey, Environmental Geology Notes, June 1967, Number 16, 15 pp, 3 map, 2 tab, 19 ref.

Descriptors: *Aquifers, Hydrogeology, *Water resources, Hydrologic data.
Identifiers: Shelbyville, Illinois, Kaskaskia river.

The impending construction of a multipurpose reservoir on the Kaskaskia river, northeast of Shelbyville, Ill., and its possible effect on the water resources of that city prompted the city to consider long-range plans for its water supply. To this end a study of the water supply, presently provided by an

aquifer system, was made. The present well field and areas for future water resource development are outlined. A quantitative appraisal of the system; estimates of potential yield of the aquifer, projection of water needs, and the economics of alternative sources of water, was carried out. It is suggested that relocation of the wells presently used, could triple the maximum daily pumpage; also the development of other sites in the area could be used for additional water supply. A ground reservoir of fairly high potential and the lake formed by the dam provide alternative sources of municipal water supply, giving Shelbyville considerable flexibility in water resource planning (Gargola-Chicago)
W69-00179

GEOLOGIC FACTORS IN COMMUNITY DEVELOPMENT AT NAPERVILLE, ILLINOIS,
Illinois State Geological Survey.
James E. Hackett.
Environmental Geology Notes, Number 22, June 1968, 16 pp, 4 fig, 11 ref.

Descriptors: Bed rock, Dolmite, Non structural alternatives, Flooding, *Impaired water quality, *Geologic investigations, *Water supply, Ground water, Low flow, Stream flow, Drainage basin.
Identifiers: Naperville, Ill., West Branch Dupage River, Spring Brook.

Expansion of the city by incorporation of tracts of land for subdivision and for industrial and commercial use has resulted in expansion of community service facilities for water, sewerage disposal, and storm water drainage control. Because Naperville is surrounded by unurbanized land it will continue to grow, necessitating comprehensive plans to meet future development needs. Information on geology, ground water resources, stream flow, and extent of flooding was gathered and related to various aspects of community development. Certain significant problems become evident: construction in areas subject to flooding and areas of poor drainage; impaired water quality due to the fact that Naperville is at the downstream end of the drainage basin in the county; legal and physical hindrances prevent other sources from being used, water supply must be had from underground sources. Considering these factors recommendations for future planning policies are outlined. (Gargola-Chicago)
W69-00183

WATERFRONT HOUSING
San Francisco Bay Conservation and Development Commission, San Francisco, California.

San Francisco Bay Conservation and Development Commission, December 1967, 37 pp, 12 fig.

Descriptors: Bays, Future planning, Urbanization, Community development, Public rights.
Identifiers: San Francisco Bay Area.

In recent years demand for housing in the San Francisco Bay area has greatly increased. The Bay area's accessibility and aesthetic appeal contribute to this increase, along with other factors such as rising incomes and increased economic feasibility. However, housing is not a necessary use of the shoreline and should not be allowed to displace those uses that of necessity must have waterfront locations. As an initial guide certain criteria should be followed, i.e. residential development should complement, not interfere with the value of the Bay as a habitate for fish and wildlife and the ability of the Bay to assimilate wastes. Planning for residential development should closely follow the adopted plans of the cities and counties around the Bay and contribute to enhancement of appearance and increase of public access. Other criteria proposals for development are discussed and twelve planning proposals for Bay area development are outlined. (Gargola-Chicago)
W69-00184

WATER FOR OREGON,
U. S. Geological Survey.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-00191

WATER SUPPLY AND POLLUTION CONTROL ASPECTS OF URBANIZATION,
Duke Univ., Durham, N. C., School of Law.
Edward H. Bryan.
Law and Contemp Prob, Vol 30, No 1, pp 176-192, Winter 1965. 17 p, 2 tab, 18 ref.

Descriptors: *Water pollution control, Water pollution effects, Water pollution sources, Water pollution treatment, Administration, Water resources development, *Urbanization, *Civil engineering, Sanitary engineering, *Water supply, Water quality control, Cost comparisons, Waste water treatment, Research and development, Economics.

The need to develop new technical approaches and suitable legal and political structures for the control of pollution on a regional basis are discussed from a civil engineering viewpoint. Water supply and pollution are properly approached as aspects of a single problem. Water resources in terms of quantity are inexhaustible provided the quality of wastewater is sufficiently improved prior to its return to lakes and streams thus keeping waterways in satisfactory condition and enabling downstream users to withdraw water of useable quality. Water as a transport medium for wastes is an important function in community systems. Water pollution research still is but 'a drop in the bucket.' Costs are the greatest obstacle to effective pollution control. Urbanized America must have technically sound water management. Included tables illustrate the extent of industrial water consumption and the shift of population in Florida from rural to urban areas.
W69-00290

4D. Watershed Protection

AN APPRAISAL OF THE QUALITY OF SURFACE WATER IN THE SEVIER LAKE BASIN, UTAH, 1964,
U. S. Geological Survey, Water Resources Division, Salt Lake City, Utah.
D. C. Hahl, and J. C. Mundorff.
Utah Dep of Natural Resources Tech Publ No 19, 1968. 44 p, 8 tab, 15 fig, 2 plate, 30 ref, append.

Descriptors: *Water quality, *Surface waters, *Hardness, *Salinity, *Irrigation water, Rivers, Sampling, Utah.
Identifiers: *Sevier Lake Basin, Utah, *Salinity hazard (Water), Sodium hazard (Water).

Dissolved solids concentration in the water of streams in the Sevier Lake Basin was found to range from 60-1,700 ppm (1964 water yr). The water is hard, of the Ca--bicarbonate type. In the East Fork and upstream part of Sevier River it had less than 500 ppm dissolved solids, mainly Ca, Mg, and bicarbonate, and hardness was 142-212 ppm. In the central reach of Sevier River, the concentrations of TDS and hardness increase. At Sevier Bridge Reservoir TDS concentration was 1,700 ppm, mostly Na and chloride, and hardness was 595 ppm. Salinity hazard is high to very high and sodium hazard is low to high. Concentration of TDS in the San Pitch River varies from 300 ppm upstream to 1,700 ppm below Gunnison Reservoir, and the composition changes from Ca-bicarbonate to Na-chloride. Salinity hazard is low to medium and sodium hazard is low. Below Sevier Bridge Reservoir, river water is diluted by springs and is less concentrated. Beaver River has less than 500 ppm TDS. Sediment concentrations in all streams range from less than 500 ppm 50% of the time to over 5,000 ppm only 5% of the time. Most sediments are carried in a few days a yr of high discharge. (Knapp-USGS)
W69-00091

EROSION CONTROL IN RELATION TO WATERSHED MANAGEMENT,
SCS, U. S. Department of Agriculture, Washington, D. C.
William R. Moore, and C. E. Smith.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR3, Pap 6126, pp 321-331, Sept 1968. 11 p, 4 fig, 2 tab, 8 ref.

Descriptors: *Erosion control, *Sedimentation, *Watershed management, *Multiple-purpose projects, *Benefits, Channel erosion, Structural design, Pollution abatement, Water quality control, Water resources development.
Identifiers: *Sheet erosion, *Sediment deposition, Flood Control Act, Public Law 566.

A review is given of the modern concept of watershed management and what that management concept implies to different people in the light of different kinds of activities and objectives. Erosion control aspects are presented in considerable detail covering the significance and types of erosion and sediment problems, erosion control measures, and the small watershed approach with its benefits. Erosion and sediment problems in the U S annually cost $1 billion loss or 1/4 of all soil and water losses. Sources and magnitude of sheet erosion, channel erosion, and wind erosion are described. Kinds and effectiveness of land treatment and structural measures are explained. Of 8,300 potentially feasible small watershed projects, about 325 were accorded needed installations under provision of the Watershed Protection and Flood Prevention Act, PL-566 (1954), and 6 million acres had been treated with erosion control practices by June 1966 with accumulated benefits totaling about $52 million. (Lang-USGS)
W69-00107

PUBLIC WORKS AUTHORIZATIONS, 1968-RIVERS AND HARBORS-FLOOD CONTROL AND MULTIPLE PURPOSE PROJECTS-PART II.
U. S. Congress Senate Comm on Public Works.

U S Senate 90th Congress, 2nd Session, Hearings Before the Subcommittee on Flood Control-Rivers and Harbors of the Committee on Public Works, April 22, 1968.

Descriptors: *Legislation, Federal government, Political aspects, Public benefits, *Government finance, Federal budgets, *North Dakota, *Missouri River, Flood control, Bank erosion, Soil erosion, Stream erosion, Erosion control, Bank protection, Stream stabilization.

The subcommittee on Flood Control-Rivers and Harbors met to consider Senate Bill S 537, 90th Congress, providing for additional bank stabilization work and maintenance on certain portions of the banks of the Missouri River between Garrison Dam and Oahe Reservoir, North Dakota. The bill would amend 77 Stat 840, which provided $3 million of federal funds for flood control in the Missouri River Basin, to provide for an additional $7 million. The subcommittee heard testimony from thirteen witnesses and received additional data submitted for the record. The testimony showed that portions of the banks of the Missouri River are subject to rapid erosion caused by sharp fluctuations of silt-free water released from Garrison Dam. The testimony also showed that many facilities as well as valuable farm land are in immediate danger from the erosion. Recommendations from the Secretary of the Army, Bureau of the Budget, and Office of the Chief of Engineers favored a $2 million increase and no provision for maintenance. The final disposition of the bill is not stated. (Molica-Fla)
W69-00325

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05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification OF Pollutants

TURBIDITY MEASUREMENTS AS AN INDICATOR OF SOLIDS CONTENT OF NEUTRALIZED MINE WATER,
U. S. Bureau of Mines, Pittsburgh Mining Research Center, Pittsburgh, Pa.
Maurice Deul.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 35-37, May 1968. 3 p, 2 tab, 7 ref.

Descriptors: *Acid mine water, *Suspended load, *Turbidity, *Monitoring, Particle size, Waste water treatment, Suspension, Water quality.
Identifiers: Neutralized acid mine water, Turbidity monitoring.

Turbidity measurements are accurate indicators of suspended solids content only for a narrow range of sizes and solids composition. For acid mine waters neutralized with lime or limestone, the suspended solids content as estimated by a Jackson candle turbidity apparatus diverges greatly from the actual solids content determined gravimetrically. Experimental results presented show that turbidity measurements do not give an accurate estimate of the concentration of suspended solids in neutralized mine water effluent. The suspended solids that can be expected in neutralized acid mine water effluents vary in composition, particle size and shape, and color. Especially important, in view of the sources of error in turbidimetry, is the presence of substances like gypsum, hydrous iron oxides, and calcium carbonate which may change in particle size with time and variation in composition of the water treated. (Knapp-USGS)
W69-00094

WATER RESOURCES DATA FOR PENNSYLVANIA, 1965--PART 2. WATER QUALITY RECORDS.
U. S. Geological Survey, Water Resources Division, Washington, D. C.

U S Geol Surv Duplicated report, 1968. 211 p, 1 fig, 19 ref.

Descriptors: *Water quality, *Pennsylvania, *Water chemistry, *Data collections, Water analysis, Hardness (Water), Streamflow, Discharge (Water).
Identifiers: *Chemical analysis (Water), *Periodic observations.

Water quality data collected in Pennsylvania in 1965 are presented. Chemical quality, fluvial sediment, and water temperature data including concentrations of silica, aluminum, iron, manganese, calcium, magnesium, nitrate, total dissolved solids, and dissolved oxygen are tabulated. Temperature data were taken once daily and on continuous recorders. In addition to the list of references, a table of annual water-supply papers on quality of Pennsylvania waters is included. (Knapp-USGS)
W69-00108

TODAY'S PROBLEMS OF INDUSTRIAL WASTE WATER POLLUTION ABATEMENT,
R. Nebolsine.
Natural Resources Lawyer, Vol 1, No 1, p 39-57, Jan 1968. 19 p, 21 ref.

Descriptors: *Pollution abatement, *Water pollution, *Industrial wastes, *Waste water, Water pollution treatment, Water consumption, Costs, Water resources, Water utilization, Water pollution sources, Water users, Water quality, Federal government, Water pollution control, Waste water treatment.

The article deals with the industrial waste problems in relation to pollution problems from other sources. Remedies and methods of achieving them are outlined. The author considers water quality standards, the costs of pollution abatement to industries, a program for pollution abatement, and the means for encourageing industries to comply. He attempts to predict what future developments will concern the area. Through the combined efforts of industry and government the problems can be largly solved within the next few years. (Horner-Fla)
W69-00328

OPTIMIZING SAMPLING INTERVALS,
Daniel, Mann, Johnson, and Mendenhall, DAMOC/WHO, Istanbul, Turkey.
Charles G. Gunnerson.
Proc IBM Sci Computing Symp Water and Air Resources Manage, pp 115-140, Oct 1967. 26 p, 14 fig, 2 tab, 17 ref, 2 append.

Descriptors: Analytical techniques, Data collections, Data processing, Evaluation, Frequency analysis, Frequency, *Optimization, Regression analysis, *Sampling, *Time series analysis, Variability, *Timing, Time lag, Hydrologic data, Dissolved oxygen, Statistical methods, Stream gages, Water quality control.
Identifiers: *Spectral analyses.

Several methods of obtaining the optimum sampling intervals (minimum number of readings consistent with sufficient data collection) for various water studies were investigated. A plot of sampling interval vs the extreme, mean, and quartile values of DO and specific conductance for the Potomac River showed that little change resulted from sampling at intervals of less than 12 hrs. Frequency distribution plots of coliform bacteria on several rivers indicated optimum sampling intervals and timing for several study requirements. Departures from continuous data plots of stream flow for various selected sampling intervals gave optimum intervals for different sized drainage basins. Spectral analyses was applied to measurements of DO, specific conductance and surface currents for several rivers, with the results shown in figures. Regression analysis on sequentially selected data, and other sequential selection methods were discussed. It was concluded that spectral analyses appeared to be the best method of finding optimum sampling intervals. A bibliography and the theory and techniques of spectral analysis were appended. (Gysi-Cornell)
W69-00340

AN EARTH-SMELLING COMPOUND ASSOCIATED WITH BLUE-GREEN ALGAE AND ACTINOMYCETES,
California Univ., Berkeley.
Lloyd L. Medsker, David Jenkins, and Jerome F. Thomas.
Environ Sci Technol, Vol 2, No 6, pp 461-64, Jan 1968. 4 p, 4 fig, 14 ref.

Descriptors: *Water analysis, *Odors, *Odor producing algae, Eutrophication, Alcohols, Actinomycetes, Cyanophyta, Spectroscopy, Gas chromatography, Analytical techniques, Water pollution sources.
Identifiers: Proton magnetic resonance spectrometry, Oscillatoria tenuis, Ramman spectroscopy, Mass spectrometry, Symploca muscorum.

A compound, with earthy-musty odor similar to that often causing problems in food and water supplies, was isolated by preparative gas chromatography from a culture of actinomycetes (No 18) and cultures of 2 species of cyanophytes, Symploca muscorum and Oscillatoria tenuis. Actinomycetes were grown in medium (M sub 1 B sub 2); cyanophytes, in Hughes medium 11 (16 liters at 26-28 deg C and 200-300 ft-candles of light). The former yielded ca 200 microg/l after 8-12 days at room temp; Symploca, 1 mg/vessel after 4-6 wk. Cyanophyte cultures were shown to be free of contaminating actinomycetes. Mass spectrum of the compound showed it to be identical with that of geosmin (C sub 12 H sub 22 0). Various analytical techniques (degradation, bromination, hydrogenation, analytical gas chromatography, high resolution mass spectrometry, infrared spectrometry and proton magnetic resonance spectrometry) showed that geosmin is a dimethyl substituted, saturated, tertiary alcohol with 2 rings in which the hydroxyl group is very sterically hindred. Structure of the ring system is unknown, but Ramman spectroscopy indicates that it may be similar to alpha-pinene. Geosmin is a colorless, viscous liquid, with camphorish odor (when concentrated) which becomes earthy upon dilution. A threshold odor of 0.05 microg/l is reported. (Eichhorn-Wisc)
W69-00387

5B. Sources of Pollution

WHITE V LONG (STREAM POLLUTION).

12 Ohio App 2d 136, 231 N E 2d 337-340 (Ohio Ct App 1967).

Descriptors: *Odor, *Public rights, *Relative rights, *Ohio, Natural streams, Effluent streams, Sewage treatment, Sewage effluents, Judicial decisions, Nuisance, Water pollution, Detergents, Phosphates, Potable water, Water purification, Biochemical oxygen demand, Local governments, Remedies.
Identifiers: Injunctions.

Action was brought to enjoin operation of a sewage disposal plant discharging effluent in the form of treated, purified water into a small natural watercourse 200 feet upstream from plaintiff's property. Although odor was detectible 15 to 75 feet from the stream, it was not noticeable at plaintiff's house. The water contained effluent with a small amount of odor producing matter; some phosphates, due to detergents, which would cause foaming; and 6 parts BOD per million. It was potable for humans and livestock. There was practically no pollution and the effluent was below the standard permitted by the federal government. The plant was operated as part of the county sanitation system. Location, construction, and equipment were approved by government officials. The court applied the comparative injury rule, balancing public interest against plaintiff's injury, and refused to grant the injunction. (Rives-Fla)
W69-00027

BARTLETT V HUME-SINCLAIR COAL MINIMG CO (POLLUTION CAUSED BY MINES).

351 S W 2d 214-218 (Mo 1961).

Descriptors: Missouri, Judicial decisions, *Water pollution, *Pollution abatement, *Water pollution effects, *Damages, Riparian land, Pollutants, Farms, Chemical precipitation, *Coal mine wastes, Strip mine wastes.

This was an action for damages resulting from pollution of streams through coal mining operations. It was held that (1) testimony of lay witnesses was competent to establish pollution, (2) where injury is temporary or remedial, the measure of damages is not the depreciation in value but the depreciation of rental or usable value during the injury, and (3) that defendant's right to control the mine land was immaterial if pollution occurred on land under defendant's control. (Crabtree-Fla)
W69-00033

GROUND-WATER HYDROLOGY PERTAINING TO SURFACE MINING FOR COAL--SOUTHWESTERN INDIANA,
Indiana University, Water Resources Research Center, Bloomington.

Don M. Corbett.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 164-189, May 1968. 25 p, 3 tab, 2 fig, 9 ref.

Descriptors: *Spoil banks, *Surface-groundwater relationships, *Rainfall-runoff relationships, *Recharge, *Water storage, Stripmine lakes, Stripmine wastes, Coal mines Aquifers, Indiana.
Identifiers: Man-made aquifers, Environmental changes, Coal mining.

Cast overburden, resulting from strip mining for coal in Pike County, southwestern Indiana, increases surface permeability and forms extensive man-made surficial aquifers. Increased infiltration and storage materially reduce evaporation, flood flows, and crests in wet periods, and increase both base and storm flows during dry periods in summer and fall. Final cuts form lakes which are replenished by outflow from the adjacent cast-overburden bodies. Precipitation and runoff data from 2 watersheds, one of which is extensively strip mined and the other not, are tabulated and compared. Storm runoff is 62% lower, and peak runoff is 56% lower in the mined than in the unmined watershed in wet periods. Maintenance of soil saturation and base flow in mined areas in dry periods increases both base and peak flow, but in the period of record, runoff intensity exceed 10 cfs per sq mile only once. (Knapp-USGS)
W69-00093

SOURCES OF SALINE WATER IN THE UPPER BRAZOS RIVER BASIN, TEXAS,
U. S. Geological Survey.
For primary bibliographic entry see Field 03C.
For abstract, see .
W69-00136

WATER QUALITY AS AFFECTED BY A WYOMING MOUNTAIN BOG,
Department of Agriculture, Forest Service, Laramie, Wyoming.
David L. Sturges.
Water Resources Research, Vol 3, No 4, pp 1085-1089, Fourth Quarter 1967. 5 p, 1 fig, 3 tab, 7 ref.

Descriptors: *Water quality, *Bogs, Potable water, Wyoming, Peat, Rocky Mountain Region, Fluctuation, Effluent stream, Groundwater.
Identifiers: Wyoming mountain bog, Elk Creek bog, Location difference, Mountain bog.

Waters collected July through October 1965 at a Wyoming mountain bog were analyzed for potability and seasonal changes in calcium, magnesium, potassium, iron, and silica. Four locations were sampled: effluent stream, fissure locations in the bog, peat locations in the bog, and groundwater. The color and turbidity of peat water greatly exceeded that at other locations and the maximum levels established by the U.S. Public Health Service for drinking water. The dissolved mineral content of all waters was very low, and the waters were of excellent chemical quality. All waters contained coliform organisms, probably of a nonfecal origin in peat and fissure water. The concentration of minerals in peat water remained constant through the sampling period. Mineral concentrations in groundwater increased in September, when the water table was at a seasonal minimum, but decreased in October following water table recharge. Silica levels were higher than other ions at all locations; the highest levels were in peat water. (Seneca-Rutgers)
W69-00199

PREDICTING RETURN FLOWS FROM IRRIGATION,
Bureau of Reclamation, U S Department of the Interior, Denver, Colorado, Office of Atmospheric Water Resources.
Patrick A. Hurley.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR1, Pap 5838, pp 41-48, Mar 1968. 8 p, 3 fig, 3 tab, 3 ref.

Descriptors: *Return flow, *Irrigation, *Surface-groundwater relationships, Drainage effects, Drains, Deep percolation, Evapotranspiration.
Identifiers: Transient storage, Graphical solutions.

An analytical method for computing return flow or drainage from irrigation applications is presented and discussed. Computations consider aquifer properties, drain specing, and deep percolation. A graph for determining the fractional part of percolation remaining in transient storage is included. By using the graph and simple digital procedures, realistic estimates of irrigation return flow can be determined. The method was used to determine monthly quantities for 13 yr of return flows in the Mesilla Valley, New Mexico-Texas. (Author)
W69-00248

WATER AND WATER COURSES - POLLUTION,
Detroit Univ. Law School.
Leonard J. Simasko.
U of Detroit L J, Vol 16, No 4, pp 211-212, May 1953.

Descriptors: West Virginia, *Pollution abatement, Municipal wastes, State jurisdiction, Water law, Legislation, Water pollution.
Identifiers: Police power.

The West Virginia court held that a municipality could be enjoined by the State Water Commission from polluting certain rivers. City of Huntington v State Water Commission, 73 S E 2d 833 (W Va 1953). In matters of statewide interest such as watercourses a municipality can be compelled to carry out plans of the state and to perform duties imposed by the state. In addition to the enforceable interests of lower riparian owners with respect to quality and quantity of natural flow, the police power of the state provides a basis for statutory restrictions such as those here involved against pollution. That others are also polluting a watercourse or that a city is financially unable to comply with a court order is no defense.
W69-00265

WATER PROBLEMS IN THE SPRINGFIELD-HOLYOKE AREA, MASSACHUSETTS - A LAYMAN'S LOOK AT WATER IN THE METROPOLITAN AREA,
U S Geological Survey.
For primary bibliographic entry see Field 03C.
For abstract, see .
W69-00293

PARTICULAR PROBLEMS OF WATER POLLUTION UNDER NEW YORK LAW AND FEDERAL LAW.
Buffalo Univ.

Buff L Rev, Vol 10, No 3, pp 473-506, Spring 1961. 34 p, 177 ref.

Descriptors: *New York, *Water pollution, Remedies, *Pollution abatement, Waste disposal, Riparian rights, Human pollution, Impaired water quality, Relative rights, Sewage disposal, *Reasonable use, Natural use, *Water pollution control, Financing, Economic feasibility, Financing feasibility, Industrial wastes.
Identifiers: International pollution control, Federal pollution control.

The basic criterion of the right of a riparian to pollute a stream under the common law of New York is that of reasonable use. This criterion is to be determined on a case by case basis. In each case, the reasonableness of the pollution is influenced by many factors. The important factors are whether the riparians are public or private, industrial or residential, the size of the stream, whether the stream is navigable or non-navigable, and the purpose for which the water is being used. The common law remedies for pollution are analyzed with a conclusion that the battle to control pollution by these remedies has been lost because of prescriptive rights, the reasonable use doctrine, and the inaction of riparian owners to exercise their rights. The article comments generally on the New York Water Pollution Act of 1949, using cases to illustrate its major problem, which is financing. The specific pollution problems in New York are mentioned along with a discussion of Federal and International (Canada) controls, which points out that New York State is not a fervent pollution abater.
W69-00304

RULES OF STATE BOARD OF HEALTH - POLLUTION OF WATERS.
State of Florida, Tallahassee.

Fla Admin Code, Ch 170c-5, pp 51-54B. 6 p.

Descriptors: Drainage wells, *Regulation, *Administrative agencies, Water properties, Water quality, *Florida, Standards, Water policy, *Water analysis, Thermal conductivity, Color, Odor, Toxicity, Turbidity, Oxygen, Testing, Permits, Water pollution control.

This chapter deals with the classification of waters and the regulation of drainage wells. The waters of Florida are classified according to usage. The five classes of waters are: Class I - public water supply; Class II - shellfish harvesting; Class III - recreation, and propagation and management of fish and wildlife; Class IV - agricultural and industrial water supply; and, Class V - navigation, utility and industrial use. The criteria for these classes are set forth according to the following categories: sewage, industrial wastes, or other wastes; odor; pH; dissolved oxygen; toxic substances; bacteriological quality; temperature; deleterious; and, turbidity. Each class is defined in terms of the categories applicable to it. A permit is required for the use or drilling of any drainage well. Application for this permit must contain specified data. Certain drilling requirements must be met. Test wells and abandoned wells must be filled with cement. (McDermott-Fla)
W69-00318

THERMAL POLLUTION OF WATER SYSTEMS,
Rutgers, The State Univ, New Brunswick, N J.
Burton Davidson, and Robert W. Bradshaw.
Environ Sci and Technol, Vol 1, No 8, pp 618-630, Aug 1967. 13 p, 8 fig, 2 photo, 34 ref.

Descriptors: *Analog computers, Biochemical oxygen demand, *Dissolved oxygen, Fishkill, Stream improvement, Optimization, *Simulation analysis, *Thermal pollution, *Temperature control, River systems, Water pollution control, Oxygen requirements, Effluents, Enthalpy.
Identifiers: Deterministic models, Purification effects, Material balance.

Simulation techniques were used to obtain the optimal stream temperature profile which resulted in maximum DO levels at every point downstream from a single source of pollution. An analog computer was used for the study. The one-dimensional, steady-state, deterministic model used was that derived by Pontryagin. The model consisted of three main elements; (1) continuous deterministic performance equations for BOD and DO (based on the work of O'Connor and Dobbins) and initial conditions; (2) a piecewise continuous decision vector function and constraints; and (3) an objective function (maximization of stream DO). Results of hypothetical examples for two intitial DO levels and four initial BOD levels were shown in graphical form. The internal consistencies of the optimal curves were checked by working the problems in reverse to obtain the BOD and DO material balances. It was concluded that hot effluents do not necessarily have an adverse effect on the DO level of a stream. (Gysi-Cornell)
W69-00343

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THE RELATION OF HUMIC COLOR TO IRON IN NATURAL WATERS,
Minnesota Univ., Minneapolis, Limnological Research Center.
Joseph Shapiro.
Verh Int Verein Limnol, Vol 16, pp 477-484, Stuttgart, Germany. Dec 1966. 8 p, 5 fig, 2 tab, 4 ref, disc.

Descriptors: Eutrophication, *Humic acids, *Iron, Water chemistry, Water quality, Color.
Identifiers: Discoloration, Peptisation.

At pH and redox values of most natural waters, iron (Fe) is insoluble. Such waters, filtered through membrane filters and analyzed for Fe, show concentrations 8-9 orders of magnitude greater than the theoretic limit. Since natural waters highly colored with humic matter usually contain high Fe concentrations, it may be supposed that compounds responsible for the discoloration may also act to hold Fe in 'solution.' Humic waters were extracted chemically (treated with cation exchange resins, solvent-extracted, freeze-concentrated and dried). Fe, added to solutions of yellow acids (YA) so obtained, was rendered filterable to degrees varying with pH of the solutions, cationic composition of the medium, and nature of the functional groups of the YA. At pH 10, solutions of YA hold concentrations of Fe (ca 80 micromoles/mg YA) 13 times greater than those at pH 5. Cations with high valence tend to coagulate Fe in solutions of YA more extensively than those with lower valence. Chemical modification of functional groups of YA altered their holding capacity. These experimental data suggest that YA not only form complexes with Fe but also act through their -COOH functional groups to form protective sols (peptisation) of collodial Fe (III). (Eichhorn-Wisc)
W69-00385

5C. Effects of Pollution

WILKINSON V HEALD (COST SHARING BETWEEN DRAINAGE DISTRICTS).

127 N W 2d 622-625 (1964).

Descriptors: Iowa, Judicial decisions, Outlets, *Drainage districts, River systems, *Repairing, *Maintenance costs, Ditches, *Cost sharing, Financing, Cost-benefit analysis.
Identifiers: *Common outlets.

This was an action between two drainage districts. The issue was the allocating of payment for repairs to a drainage ditch in one of the districts. The lower district, where the repairs were made, claimed that the upper district should bear part of the cost because the repaired drain was a common outlet. The upper district objected to payment because the two districts were separated by 1 fourth of a mile, and therefore maintained that the repaired ditch was not a common outlet. It was held that the repaired ditch was a common outlet and that the upper district must pay part of the expense. (Crabtree-Fla)
W69-00015

VAN BROCKLIN V GUDEMA (WELL WATER POLLUTION CAUSED BY NEGLIGENCE OF ADJOINING FARMOWNER).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00058

WILLIAMS V PENDLETON MFG CO (WATER POLLUTION IN NONNAVIGABLE CREEK).

244 S C 228-236, 136 S E 2d 291-296 (1964).

Descriptors: Ammonia, Chemical analysis, *Nitrates, *Chemical wastes, Industrial wastes, Water pollution, Riparian rights, South Carolina, Nitrogen compounds, Poisons.
Identifiers: Water Pollution Act, *Cyanide, Cyanide poisoning, Nitrate poisoning.

Defendant's company operated a manufacturing plant four miles upstream from the land of plaintiff's father. Defendant had discharged spent industrial dye stuffs into a creek flowing through this property for years. Plaintiff owned five cows which grazed this land. Four cows died of cyanide or nitrate poisoning within three hundred yards of the creek. The fifth survived with treatment. It was held that there was sufficient evidence that there were nitrates in the manufacturing plant's discharges to go to the jury. The judge properly excluded evidence of a test made of the creek one year prior to the incident. The judge, however, committed prejudicial error in charging the jury in accordance with the Water Pollution Act. There was no evidence of a violation of this Act. Furthermore, causes of action arising from violations of this Act inure solely to the State of South Carolina. The Act was not intended to create new or enlarge existing common law or statutory rights for riparian owners or others. The case was reversed and remanded for a new trial. (McDermott-Fla)
W69-00060

THE EFFECTS OF STRIP MINING ON THE MICROBIOLOGY OF A STREAM FREE FROM DOMESTIC POLLUTION,
Kentucky University, Department of Microbiology, Lexington.
Ralph H. Weaver, and Harry D. Nash.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 80-97, May 1968. 16 p, 5 tab, 17 ref.

Descriptors: *Acid mine water, *Aquiatic microorganisms, *Algae, *Aquatic bacteria, *Aquatic fungi, Yeasts, Hydrogen ion concentration, Iron, Sulfate, Temperature, Kentucky.
Identifiers: Acid waste microflora, McCreary County, Kentucky.

The microflora of Cane Branch, McCreary Co., Kentucky, which drains a strip-mined area, and Helton Branch, which drains a similar but nonmined area, were studied to determine the biological effects of acid mine drainage. Numbers and types of bacteria, fungi, yeasts, and algae, from both surface and bottom samples, as well as temperature and pH were studied to learn the changes of ecology with dilution and recovery. These data are tabulated by season and stream. Iron oxidizing bacteria appear to be indigenous in acid mine water and directly associated with acid formation. Ferrobacillus ferroxidans was found in Cane Branch in all seasons, but only in summer in Helton Branch. The lowering of pH to 3.0-4.1 from 6.3-6.7, with an increase in sulfates and almost total elimination of bicarbonate alkalinity, resulted in the alteration of microflora in Cane Branch, primarily the establishment of F. ferroxidans. The role of fungi in stream chemistry is as yet unknown. Cane Branch algal growth and diversity of types increased with distance from the surface of pollution where Bumilleria, which is found only in streams with acid mine waste, was the only genus present. (Knapp-USGS)
W69-00096

THE RELATIVE INFLUENCE OF IRON, SULFATE AND HYDROGEN IONS ON THE MICROFLORA OF A NON-ACID STREAM,
Ohio State University, Faculty of Microbial and Cellular Biology, Columbus.
Bruce McCoy, and Patrick R. Dugan.
Reprints of Pap 2d Sump on Coal Mine Drainage Res, Mellon Inst, pp 64-79, May 1968. 16 p, 3 tab, 8 fig, 6 ref.

Descriptors: *Acid mine water, *Aquatic bacteria, *Hydrogen ion concentration, *Iron, *Sulfate, Pseudomonas, Sulfur bacteria, Waste water (Pollution), Mathematical models.
Identifiers: *Flavobacterium, Heterotrophic aerobes.

The influence of acid mine drainage on the microflora of normal streams was studied to determine the extent of abatement required to restore acid polluted streams. A growth medium was used which simulated the stream nutritionally. Water composition was varied systematically in sulfate, ferric iron and pH. Survival of bacteria was correlated with variation of ionic composition and mathematical models were developed to fit the data. Relationships developed from the models were experimentally tested. The bacteria studied, Pseudomonas (M-1), Flavobacterium (M-2), and Bacillus (M-3), grow when pH is above 5.3 if iron levels are in the range 1-100 mg per ml and sulfates in the range 50-500 mg per ml. Growth increased with iron content when pH was over 5. The effect of sulfate was nonlinear and dependent on acidity; the most important variable was pH. Control measures should emphasize removal of acidity and sulfate by use of sulfate-reducing microbes, and prevention of pollution should also be emphasized. (Knapp-USGS)
W69-00098

STOCHASTIC MODEL FOR POLLUTION AND DISSOLVED OXYGEN IN STREAMS,
Virginia Polytechnic Institute, Blacksburg.
Richard P. Thayer, and Richard G. Krutchkoff.
Water Resources Res Center Rep, Va Polytech Inst, 1966. 109 p, 14 fig, 10 tab, 13 ref.

Descriptors: *Water pollution, *Stochastic processes, *Mathematical studies, *Statistical models, *Synthetic hydrology, Biochemical oxygen demand, Chemical oxygen demand, Dissolved oxygen.
Identifiers: Stochastic stream-pollution model.

A stochastic model was developed to provide a joint density function at any point downstream for both pollution and dissolved oxygen in a stream when initial conditions of BOD, COD, pollution inflow rate, pollution and oxygen decrease rate, and reaeration rate are assumed. The digital computer programs used are included. The method was checked against observations of oxygen content and scatter of data on the Sacramento River, and the results agreed. The model was also checked by mixing sugar and other nutrients with pond water, aerating the misture in cans, and monitoring changes in oxygen demand and pollution with time. (Knapp-USGS)
W69-00141

ECONOMICS OF WATER POLLUTION,
Dept. of Agriculture, Economics Research Service.
Joseph P. Biniek, and Gary C. Taylor.
Florida Univ., Institute of Food and Agri Sci, Water Research Needs: An Economic Appraisal, Pub No 3, pp 57-70, Dec. 1967. 7 p, 13 ref.

Descriptors: *Cost-benefit analysis, Pollutants, Radioisotopes, Sluices, *Federal Government, Estuarine environment.
Identifiers: Economics, *Water pollution.

Water quality is a subset of the larger field of environmental quality. There is a direct inter-relationship between polluted air, soil, and water. Water is an economic problem since it is characterized by dimensions of demand, supply, location, time, and quality. Water pollution is defined as an undesirable change in the relevant characteristics of a water supply. A classification of the origin of pollutants were listed. The costs and benefits of water pollution are inflicted by one decision making unit and borne by another without any price signals being registered in the normal market price structure. Hence, disadvantaged parties result and they try to solve the problem politically. The weighing of benefits and costs to affected parties and the design of optimizing solutions through various programs, public and private, is the economic content of the political problem of water pollution. Four major kinds of economic research appear to be needed in the water pollution area. These include economic surveys, analyses of critical problems, studies of institutions, and research to improve the analytical abilities of researchers. A partial list of sources of research data was given. (Grossman-Rutgers)
W69-00172

EFFECTS OF WATER POLLUTION IN SAN FRANCISCO BAY,
Stanford Univ., Stanford, California.
Gene E. Willeke.
Stanford U., Program in Engineering-Economic Planning, Report EEP-29, October 1968.

Descriptors: *Water pollution effects, *Social impact, Psychological aspects, Water sports, Public health, California, Attitude, Behavior, Flotsam, Ethics, Water Quality Act, Recreation demand, Intangible benefits, Turbidity, Water temperature.
Identifiers: Communication, Survey research, Discriminant analysis.

A 914-case sample survey was conducted in San Francisco Bay Area to measure attitudes toward and perception of water pollution in the Bay and to determine what effects these attitudes and perception have on use of the Bay for recreation. Information seeking, source credibility, and influence of conservation organizations were also studied. Half the respondents cited pollution as an unappealing feature of the Bay; half considered the Bay polluted. Information received, sex, and household income were good predictors. 27% believed contact with Bay water could be harmful; 28% were unwilling to eat fish caught in the Bay. Many of these same persons do not participate in recreational activities on the Bay because of perceived pollution. 24% gave pollution as a reason for not using the Bay (swimming, 20%; water skiing, 5%; fishing, 2%; boating or sailing, 2%). 1% said they had become ill or suffered harmful effects from contact with Bay water. Policy implications include need for better public information programs and more use of qualitative quality parameters. Water quality seems to be insensitively related to recreational use of a water body. (Author)
W69-00215

THE EFFECT OF PUMPED-STORAGE RESERVOIR OPERATION ON BIOLOGICAL PRODUCTIVITY AND WATER QUALITY,
Virginia Polytechnic Inst., Blacksburg.
S. E. Neff, and G. M. Simmons, Jr.
OWRR Project No. A-012-VA, Aug 1968. 26 p, 3 fig, 2 tab.

Descriptors: Coliforms, Effluents, Industrial wastes, Sewage effluents, Limnology, Water temperature, Chemical properties, Primary productivity, Pumped-storage, Reservoirs, *Reservoir operation, *Eutrophication, Radio carbon, Thermal stratification, Water pollution effects.
Identifiers: Virginia, Smith Mountain Lake, Carbon-14 method.

Smith Mountain Lake, Virginia is a pump-storage impoundment in which quantities of water are recycled on a daily and weekly basis. The reservoir behaves as a warm monomictic lake. Annual temperature and oxygen distribution show tendencies toward eutrophy. Recycling affects the stratification of the reservoir in summer and causes mixing of water in the vicinity of the dam. Effects of mixing can be observed up to 6.5 miles from the dam. Primary productivity estimates at four stations using the carbon-14 method range from 68. to 575. milligrams carbon/meter squared/day; these yields compare favorably with mesotrophic lakes. Municipal effluents are rapidly producing changes in the upper parts of the reservoir. Productivity estimates (1800-2200 milligrams carbon/meter squared/day) in those areas reflect enrichment and eutrophic character of the water. Coliform counts also confirm enrichment and nature of the effluent. Some correlation between the standing crop of net phytoplankton and productivity estimates was observed.
W69-00230

CORNELL SCIENTISTS SEE THERMAL POLLUTION OF CAYUGA LAKE BY PLANNED NUCLEAR POWER PLANT,
Cornell Univ., New York.
A. W. Eipper, D. E. Arnold, and W. T. Bell.
The Conservationist, Vol 23, No 1, pp 2-5, 36-37, Aug-Sept 1968. 6 p, 1 map, 2 photo.

Descriptors: *Thermal pollution, *Thermal powerplants, *New York, Nuclear reactors, Thermal stratification, Epilimnion, Hypolimnion.
Identifiers: Cayuga Lake, New York.

The present status of Cayuga Lake, the predicted effects of a proposed nuclear power plant on its thermal and nutrient structure, and the predicted impacts of these changes on the aquatic environment are described. Power plant design modifications similar to those already in use elsewhere at other such plants to eliminate thermal pollution are suggested. Cayuga Lake is 38 mi long, has a mean width of 1.7 mi, a surface area of about 66 sq mi, a maximum depth of 435 ft, a mean depth of 179 ft, and a volume of 331 billion cubic ft. The mean flushing time is 9 yr. The lake is thermally stratified in summer; the temperature in the epilimnion is 50-73 deg F and in the hypolimnion, 40-43 deg. Millikin Station, the steam power plant now operating, has a heat output of 1.3 billion BTU per hr. The proposed nuclear plant would have a heat output of 6 billion BTU per hr in a continuous water flow of 9,000 gal per sec. This would cause earlier thermal stratification, algae production, and oxygen depletion in the hypolimnion; such conditions will last longer, accelerating eutrophication. Impoundment of cooling water, the use of cooling towers, and closed-circuit cooling towers with forced-air circulation eliminate thermal pollution where they are now used and are suggested for the power stations on Cayuga Lake. (Knapp-USGS)
W69-00241

PHOSPHATE FIXATION IN ORGANIC LAKE SEDIMENTS,
Cornell Univ., Ithaca, N. Y., Conservation Dept.
Carl L. Schofield, Jr.
OWRR Project No. A-019-NY, Technical Report No 13, Cornell Water Resources and Marine Sciences Center, September, 1968.

Descriptors: *Oligotrophic lakes, *Phosphorus, Sediments, Eutrophication.

The mechanisms of phosphate fixation in organic sediments were studied in four oligotrophic lakes of the Adirondack Mountain region of New York. The forms of phosphate present were determined by sequential extraction, utilizing solvents selective for the various phosphates. Iron phosphates and occluded forms were dominant in oxidizing situations whereas aluminum phosphates were prevalent in reduced sediments. Aluminum phosphates are not as mobile as iron bound phosphates, being stable under reducing conditions. Organic phosphorus was high in all the sediments examined. Phosphate saturation was noted in one case where the sediments were largely autochthonous and low in iron and aluminum. The high soluble phosphate content in this system was conducive to higher productivity due to the high ratio of sediment area to water volume, weak thermal stratification, and low flushing rate. (Author)
W69-00271

A MODERN APPROACH TO THE STUDY OF ESTUARIES, WITH SPECIFIC REFERENCE TO THE DUWAMISH RIVER, WASHINGTON,
Washington Univ., Seattle.
Denny M. Miller, J. A. Wetherall, and William H. Lenarz.
Sponsored by FWPCA. Transactions of the Thirty-second North American Wildlife and Natural Resources Conference. Vol. 32, pp. 165-173, March 1967. 9 p, 1 fig., 4 ref.

Descriptors: Water pollution, Estuarine fishes, Computer models, Simulation analysis, Water quality, Mathematical models, Chinook salmon, Smolt, Mortality, Distribution, Growth rates, Marking techniques.
Identifiers: Time series analysis, Spectral analysis, BOMM, Co.

A synthesis of new and old methods is providing an effective approach to the study of complex ecological problems in the organically enriched Duwamish Estuary, Washington. Time series analysis and computer simulation techniques will be used to build abstract models of the estuarine environment. The models may be used to predict temporal and spatial changes in environmental processes and may be a valuable tool for the management of certain fisheries. Tow net and a new mass-marking technique provide a means of quantifying information on the distribution, growth, abundance and mortality of juvenile chinook salmon in estuarine waters. In studies of the survival of downstream migrant salmon, survival estimates may be markedly biased unless the sampling procedures used are designed with particular attention to fish behavior. Simulation models may be used to estimate bias and to design sampling strategies that will reduce bias in survival estimates. (D. M. Miller-Wash)
W69-00272

WATER POLLUTION--STATE CONTROL COMMITTEE.
Vanderbilt Univ., Nashville. School of Law.

Vand L Rev, Vol 17, No 3, pp 1364-1374, June 1964. 11 p, 55 ref.

Descriptors: Water pollution, *Water pollution control, *Pollution abatement regulation, *Administrative agencies, Legislation, *Permits, Water pollution effects, Discharge (Water), Pollutants, Water quality control.
Identifiers: Proposed model act.

Many states have adopted some form of centralized administrative control of water pollution. The type of control is usually categorized as either an irrational agency or a rational agency. The distinguishing feature of an irrational agency is its assumption of overall supervision of existing agencies. The rational agency, on the other hand, takes over all pollution control in the state. Preferred is the irrational agency, because it is able to ingest different kinds of technical and non-technical knowledge and is able to cut across many lines of interest. An act should not specify what waters it will apply to for this circumscribes the power of the agency. A permit system is an effective way of controlling the discharge of water. All persons who are discharging or plan to discharge water must apply for permits. The applications must contain a description of the kinds and amounts of water with mention of treatment facilities. The agency or central committee shall grant permits after studying applications. Those refused a permit may obtain a hearing.
W69-00283

ENZYMATIC DEGRADATION OF DDT BY AQUATIC ORGANISMS,
Cornell Univ., Ithaca, N. Y., Dept. of Entomology and Limnology.
Roger G. Young.
OWRR Report A-015-NY, Cornell Water Resources and Marine Sciences Center, August 1968. 7 p, 1 tab.

Descriptors: *Enzymatic degradation, *Insecticides, Aquatic organisms, Aquatic microorganisms.

The objective of the research was to determine whether a number of mammals, fish and microorganisms had enzymatic capabilities to degrade DDT to DDE. The results of experiments involving yellow perch, brown trout and rock bass indicate that fish possess the necessary enzymes to give some degree of protection in DDT contaminated water, although more species variation might be observed in a broader survey. Preliminary tests were made to determine whether metabolic conversion of the insecticide DDT could be observed in pure cultures of some common algae. The two genera studied were Chlorella vulgaris and Ankistrodesmus flacatus. Conclusive evidence for DDT breakdown was not found in these preliminary tests. (Neno-Cornell)
W69-00310

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THE HIDDEN FLORA OF A LAKE,
Hebrew University of Jerusalem.
Menachem Rahat, and Inka Dor.
Hydrobiol, Vol 31, Fasc 2, pp 186-192, 1968. 8 p, 1 tab, 27 ref.

Descriptors: *Lakes, Plants, *Algae, *Salinity, Irrigation effects, Drainage effects, *Sampling, Algae toxins, Saline water, Equilibrium, Biological communities, *Aquatic algae, Halophytes.

A survey was conducted to determine hidden algal flora of Lake Kinneret (Sea of Galilee) in the Jordan Rift Valley, Israel, which would dominate in a rise of salinity due to disturbance of present equilibrium from drainage for irrigation. The chrysomonad Prymnesium parvum which caused toxic blooms was of particular interest. Water samples were selectively enriched for halophilic algae with an inorganic salt medium. A radical change was observed. Algae rare or unknown to the lake were present. Representation of the algal groups was as follows: 7 species belonged to Chlorophyceae, 8 species to Dratomeae and 15 to Cyanophyceae. Prymnesium parvum was present in 6 of the 27 samples. Thus it was indicated that a sufficient rise of the lakes salinity would result in a predominance of halophilic algae and the presence of Prymnesium parvum forms a potential danger of toxic blooms. (Affleck-Ariz)
W69-00360

RESISTANCE OF TILAPIA NILOTICA L TO HIGH TEMPERATURES,
Cairo Univ., Cairo, Egypt, Zoology Dept.
H. M. Bishai.
Hydrobiol, Vol 25, No 3-4, pp 473-488, 1965. 16 p, 5 tab, 2 fig, 57 ref.

Descriptors: Temperature, Thermal stress, *Heat resistance, Fish physiology, Larvae, Fry, *Acclimatization, Resistance, *Fish behavior, *Lethal limit, *Tilapia.

The effect of different high temperatures (25 deg C) was studied on varying developmental stages of Tilapia nilotica L from Khartoum. The upper lethal temperatures and temperature tolerance were measured by holding the fish of different sizes and weights at different non lethal temperatures under similar conditions. Temperature resistance was less for both early larval and adult stages than for the fry stages. The median resistance time of larval stages was greater than that of adults. Median resistance time of the fry stage increased with an increased acclimation temperature up to 35 deg C. Temperatures greater than 35 deg C caused a marked increase in the median resistance time of both larval and fry stages. The upper lethal temperature was highest for the fry stage. Sudden and large changes of high temperature did not affect T nilotica at any stage. (Affleck-Ariz)
W69-00368

NUTRIENT AND ENERGY CYCLES IN AN ESTUARINE OYSTER AREA,
Dalhousie Univ, Halifax, Nova Scotia, Inst. of Oceanography.
Fukuzo Uyeno.
J Fish Res Bd Canada, Vol 23, No 11, pp 1635-1652, 1966. 23 p, 4 fig, 3 tab, 24 ref.

Descriptors: Chemical analysis, *Cycling nutrients, *Marine bacteria, Light, Molluscs, Oysters, Ecosystems, Energy budget, Phosphates, Water pollution sources, Nitrates, *Primary productivity, Saline water, *Estuaries, *Eutrophication, Chlorophyll.
Identifiers: Energy cycles, Microbal content, Saline ponds, Prince Edward Island, Oyster area.

The nutrient circulation and microbial abundance of oyster-producing waters in the Malpeque Bay area, Prince Edward Island, were followed at 2 stations through an open season, and the efficiency of carbon assimilation and dissimilation was estimated. Part of the organic fall-out evidently entered the water again in the spring as nutrient salts, but a certain portion was not returned and this represented a net loss from the ecosystem. The nutrient circulation at a station located in a salt-water pond was more efficient than at a station located in a river estuary. At Levi Creek (Station A), high phosphate-P concentrations in September 1962 (2.10 microgram-atoms per liter) and in November (1,42 microgram-atoms per liter) might be derived from commercial fertilizer applied to cultivated fields. Occasional high values of nitrate-N were possibly due to particulate seston, and high mean values (about 4.8 microgram-atoms per liter) from July to the end of the season were attributed to rains. In the pond mineralization was 31% of primary production, largely by mud bacteria; in the estuary (Station C) it was 17%, due about equally to mud and water organisms. (Author)
W69-00386

AN EARTH-SMELLING COMPOUND ASSOCIATED WITH BLUE-GREEN ALGAE AND ACTINOMYCETES,
California Univ., Berkeley.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-00387

THE LIMNOLOGICAL BEHAVIOR OF IRON IN NATURAL WATER,
Illinois State Water Survey, Peoria, Water Quality Sect.
Wun-Cheng Wang, and Ralph L. Evans.
Presented at 156th Natl Meeting Amer Chem Soc, Atlantic City, N. J.

Descriptors: *Iron, Adsorption, Turbidity, Lakes, Limnology, Colloids, Phosphate, *Eutrophication, *Water chemistry, Silica, Nutrients.
Identifiers: *Particulate iron, Illinois, Peoria Lake, Freundlich isotherm, Langmuir isotherm.

A total of 9 sampling stations along 5 transects of Peoria Lake, Ill., were sampled at 1-2 week intervals from 13 March to 3 Oct 1967. Water samples were filtered through membrane filters and filters and filtrate separately analyzed for Fe (II) and total iron by standard phenanthroline method. Total iron ranged 0.69-13.01 mg/l with a mean of 3.21. Greatest majority of the iron was present as Fe (III) (range: 0.52-7.36 mg/l; mean : 2.63). Combined particulate iron was 8-12 times greater than combined dissolved iron. Iron input is greater than output, so an increase of iron in the lake can be expected. The particulate Fe (III) in this lake has several characteristics: It can be correlated with water turbidity; the relationship between particulate Fe (III) and water turbidity does not follow the Freundlich or Langmuir adsorption isotherms; there is significant correlation between particulate Fe (III), particulate Fe (II), particulate silica, and particulate phosphate; the ratio of particulate Fe (III)/particulate Fe (II) is higher than the ratio of dissolved Fe (III)/dissolved Fe (II). These results suggest that iron may form complexes with particulate matter. The dissolved Fe (III) concentration is in excess of its solubility; it may exist in fine colloid or complex structure. (Author)
W69-00388

INDUCED RAPID RELEASE AND UPTAKE OF PHOSPHATE BY MICROORGANISMS,
Minnesota Univ., Minneapolis, Limnological Research Center.
Joseph Shapiro.
Science, Vol 155, No 37.67, pp 1269-1271, 10 Mar 1967. 3 p, 3 fig, 1 tab, 10 ref.

Descriptors: *Phosphates, Cycling nutrients, Bioindicators, Bacteria, *Microorganisms, Eutrophication, Protozoa, Cultures, *Activated sludge, Microbiology, Sludge treatment, Sphaerotilus, Escherichia, Bacillus sereus, Flavobacterium, Vorticella, Opercularia, Epistylis, E. coli.
Identifiers: Esherichia, Bacillus cereus, Flavobacterium, Vorticalla, Opercularia, Epistylis.

Mixed cultures of sludge organism including bacteria (e.g., Zooglea remigera, Escherichia intermedium, Bacillus cereus, Flavobacterium), filimentous organisms (Sphaerotilus natans), and protozoa (e.g., Vorticella, Opercularia, Epistylis) are able to release actively a large proportion of their phosphorus (P) to the medium in a matter of hours when kept under anoxic conditions. At 30 deg C, phosphate-P rises from an initial value of 4 to 70 mg/l in 3.5 hr and as much as 40% of total phosphorus originally present in the culture is released. The process, which is completely reversible upon aeration, has a change in rate (for a change of 10 deg C) of 2 to 2.5. Uptake after reaeration is inhibited by metabolic inhibitors (dinitrophenol, mercuris chloride). The amount of phosphate released per unit of sludge remains constant for concentrations ranging from 1700 to 15,800 mg sludge/l, and higher concentrations of phosphate in solution do not inhibit release. P is lost, probably as orthophosphate principally from the acid-soluble fraction of the cells. Experiments with dense cultures of E coli showed similar results. (Eichhorn-Wisc)
W69-00389

5D. Waste Treatment Processes

MACARTOR V GRAYLAND CREST III SWIM CLUB, INC. (REASONABLE USE TEST-PERCOLATING WATER).

187 A 2d 417-421 (Del 1963).

Descriptors: *Water law, *Percolating water, *Delaware, Judicial decisions, *Reasonable use, Wells, Remedies, Water rights, Damages.

The case involves a suit to enjoin the defendant swim club from, inter alia, using a deep well on its property to the detriment of the plaintiffs' shallow well. The court first stated that in allocating rights in percolating water, an 'objective' reasonable use test would be employed. Factors favoring the adoption of this rule are given. After a careful weighing of the equities on both sides of the case, the Chancellor granted the plaintiffs' request for an injunction on the condition that plaintiffs deepen, or allow defendant to deepen plaintiff's well to a reasonable depth with the cost to be equally divided. An alternative remedy proposed by the court is that plaintiffs run, at their own expense, a line to the defendant's public water supply, plaintiffs to thereafter pay a proportion of the costs of the public water attributable to their use. (Patterson-Fla)
W69-00036

TERTIARY TREATMENT USING DIATOMACEOUS EARTH AND ACTIVATED CARBON,
Wayne State University, Dept. Civil Engineering, Detroit, Michigan.
Henry A. Dirasian.
Pap from OWRR project No A-021-Mich, Wayne State Univ, 1968. 17 p, 4 tab, 6 fig, 9 ref.

Descriptors: *Tertiary treatment, *Activated carbon, *Filtration, *Fly ash, *Diatomaceous earth, Suspended load, Chemical oxygen demand, Biochemical oxygen demand, Organic matter.
Identifiers: *Fly ash filters, *Diatomaceous earth filters.

A study was made of the effectiveness, but not the economic feasibility, of tertiary treatment of sewage by diatomaceous earth, activated carbon, and fly-ash filtration. The best results, 98.4% removal of SS and 88% of COD, were obtained using diatomaceous earth with some activated carbon. Fly ash did not work as well, but it appears desirable because of low cost. A properly graded, washed fly ash filter might yield BOD and SS removals as high as 80-90% or more. (Knapp-USGS)
W69-00109

WATER REUSE--WHAT DO WE MEAN,
George E. Symons.
Water and Waste Eng, Vol 5, No 6, pp 40-43, June 1968. 4 p, 4 fig, 1 tab, no ref.

Descriptors: *Water reuse, Artificial recharge, Irrigation water, Sewage treatment, Hydrologic cycle, Rivers, Water pollution, Water pollution treatment, Kansas.
Identifiers: *Reclamation (Waste water), Neosho River, Chanute, Kansas.

Water reuse is defined and discussed with particular attention to the various meanings to water users, the categories of reuse, and the current and future status of the processes involved. Reuse is defined as the use of treated or partially treated wastewater for any purpose that requires water free or substantially free of pollutants. Reuse may be accomplished through the hydrological cycle, the natural cycle, the indirect cycle, and the direct cycle. There is no control over the hydrological cycle. All water not undergoing any artificial process is in it. The natural cycle involves unplanned sequential use of water by communities in the direction of natural flow, and is very common on all populated river systems. The indirect cycle is the planned return of treated wastewater to the natural cycle, either to streams or groundwater recharge. The direct cycle is the planned treatment of wastewater for a specific immediate reuse. Direct-cycle reuse is a common industrial process, but has been used in municipal supplies only for emergency purposes. Indirect reuse of municipal water is increasing rapidly and is important for control of river pollution and for replenishing groundwater supplies. (Knapp-USGS)
W69-00110

FACTORS IN NEUTRALIZING ACID MINE WATERS WITH LIMESTONE,
Bureau of Mines, Dept. of the Interior, Pittsburgh Mining Research Center.
E. A. Mihok, and C. E. Chamberlain.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 265-273, May 1968. 9 p, 9 fig, 2 ref.

Descriptors: *Acid mine water, *Pollution abatement, *Waste water treatment, *Neutralization, *Calcium carbonate, Iron oxide, Acidity.
Identifiers: Iron removal.

A continuous limestone neutralization pilot plant capable of handling 100 gpm of acid-iron water was designed, constructed, and operated to study some of the factors controlling neutralization and oxidation processes. Rapid neutralization of acid water was achieved with the use of coarse crushed limestone in a rotary-kiln-type reactor. Subsequent aeration of neutralized water from the reactor removes soluble ferrous iron at the rate of 1 to 4 ppm per minute. Ferrous iron removal during neutralization and aeration is dependent on pH and temperature. In the limestone reactor, at normal mine water temperatures, soluble iron is removed at a rate of 30 to 35 ppm per minute. Although the pH of the neutralized waters ranged from 6.5 to 7.5, sufficient alkaline activity was not achieved to bring about mass precipitation of insoluble ferrous hydroxide, despite an excess of finely divided limestone remaining in suspension. The presence of an abnormally high concentration of CO_2 in the atmosphere (about 0.16 percent) at the reactor site may cause pH suppression. (Knapp-USGS)
W69-00133

TERTIARY TREATMENT USING DIATOMACEOUS EARTH AND ACTIVATED CARBON,
Wayne State University, Detroit, Mich.
Henry A. Dirasian.
OWRR Project A-021-MICH, June 1968, 18 p, 6 fig, 4 tab, 9 ref.

Descriptors: Water pollution control, *Diatomaceous earth, *Activated carbon, Fly ash, Filtration.

A study was conducted to determine the feasibility of treating secondary treatment plant effluents in a filter aid pressure type filter using diatomaceous earth as the filtering media while varying concentrations of activated carbon were added to enhance removals through adsorption; it was carried out in three phases. First, diatomaceous earth alone was used as filtering media. Next, activated carbon was added to diatomaceous earth, and finally, investigations were made using surplus fly ash as filtering media. Secondary waste treatment plant effluents can be further treated by this method and additional organic matter removed. Using diatomaceous earth alone about 65% of the BOD was removed and about 93% in suspended solids. Using diatomaceous earth and activated carbon removals as high as 88% of BOD and 98% of suspended solids were attained. This type of treatment indicated improvement in the quality of effluents discharged to the stream. Emphasis should be placed on removals using fly ash as the filtering media. It was felt that fly ash could do an acceptable job. Some consideration would have to be given to grading and washing of fly ash before use. It is recommended that further studies be conducted on fly ash filters.
W69-00223

FACTORS IN THE DESIGN OF AN ACID MINE DRAINAGE TREATMENT PLANT,
West Virginia Univ., Morgantown, School of Mines.
Charles T. Holland, James L. Corsaro, and Douglas J. Ladish.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 274-290, May 1968. 12 tab, 6 fig.

Descriptors: *Acid mine water, *Pollution abatement, *Pilot plants, *Cost analysis, *Waste water treatment, Iron oxides, Sulfate, Acidity, Lime, West Virginia.
Identifiers: *Acid mine water treatment plants, *State Water Board requirements.

A pilot plant was designed, built and operated to estimate the cost of treating acid mine drainage to meet standards of the West Virginia State Water Board. Factors investigated in the treatment of acid mine drainage are introduction of the feed water to the plant, neutralization, oxidation, sludge settling, sludge handling and disposal, land requirements, and costs. A flow sheet illustrates plant layout and the stage at which various operations are carried out. Operating expenses of a plant designed to treat 8,100,000 gpd of highly acid mine water are estimated to be 47.75 cents per 1,000 gallons, and for weakly acid water, 18.90 cents per 1,000 gallons. (Knapp-USGS)
W69-00234

REMOVAL OF IRON FROM ACID MINE WITH THE AID OF HIGH ENERGY RADIATION, PART III,
Brookhaven National Laboratory, Upton, New York.
M. Steinberg, J. Pruzansky, and L. R. Jefferson.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 308-318, May 1968. 11 p, 4 tab, 4 ref.

Descriptors: *Acid mine water, *Pollution abatement, *Waste water treatment, *Aeration, *Irradiation, Cobalt radioisotopes, Calcium carbonate, Iron oxides, Acidity, Limestones.
Identifiers: *Iron removal, Fulton Borehole acid mine drainage.

Experimental data are presented on the rate of oxidation and removal of ferrous iron from Fulton Borehole acid mine drainage, a high iron (350 ppm) acid water (pH-3.1) by mechanical agitation and aeration with a large excess of crushed limestone and with the effect of radiation. It appears that up to 83.5 ppm/min of Fe removal can be obtained with limestone neutralization alone at a pH less than 6.5 at a temperature of 10 deg C. Particle size, degree of agitation, and mass ratio of limestone to mine water appear to be important variables in obtaining high removal and neutralization rates. Whereas Co-60 gamma radiation can yield high rates and high chain G values for Fe removal in the absence of vigorous agitation, the incremental contribution of radiation decreases as the rate of neutralization by limestone increases. It would be difficult to justify a radiation process in view of the rate of iron removal that has already been observed with limestone neutralization. Based on this study and studies of the U S Bureau of Mines it is suggested that an engineering development program be undertaken for treating Fulton Borehole drainage with field limestone. (Knapp-USGS)
W69-00237

SUMMARY OF SELECTED LITERATURE ON LAGOON AND SPRAY SYSTEMS OF TREATING FRUIT AND VEGETABLE PROCESSING WASTES,
Clemson Univ., Clemson, South Carolina.
G. H. Liner, and J. M. Stepp.
Dep of Agr Econ and Rural Sociol, S C Agr Exp Sta, Clemson Univ, 26 p, July 1968. 40 ref.

Descriptors: *Waste treatment, *Lagoons, *Sprinkler irrigation, *Reviews, *Bibliographies, Aerobic treatment, Waste water disposal.
Identifiers: Fruit and vegetable processing wastes.

The literature of the treatment in lagoons or disposal by irrigation spraying of wastes from fruit and vegetable processing plants is reviewed and a comprehensive bibliography is compiled. Characteristics of cannery wastes, technology of disposal, and costs of treatment are not discussed. Nationally, 62% of processing wastes are handled by municipal facilities and 38% are disposed of by means which ordinarily do not involve treatment. Fruit and vegetable processing are highly seasonal and often plants can not afford proper treatment facilities for discharge into streams; the use of lagoons and disposal of waste by irrigation spraying is discussed as an acceptable economical alternative. (Knapp-USGS)
W69-00258

THE LEGISLATIVE APPROACH TO AIR AND WATER QUALITY,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00330

RISK EVALUATION IN SEWAGE TREATMENT PLANT DESIGN,
Cornell Univ, Ithaca, N Y.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00354

A LEAST COST EVALUATION OF DISPOSAL SYSTEMS FOR LOW LEVEL LIQUID RADIOACTIVE WASTES,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00356

5E. Ultimate Disposal of Wastes

CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
Michigan Technological Univ., Houghton.
Carl O. Gast.
OWRR Report A-019-Mich., A Master's Thesis by the author, 1968, 126 pp. 39 fig, 3 tab, 16 ref, 2 Append.

Descriptors: *Septic tanks, *Soil disposal fields, Earth water interfaces, Soil water movement, Porosity, Sewage disposal.

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A section of a septic tank drain field was constructed and tested under conditions simulating the conventional and the dosing chamber. Distribution of effluent along the length of the trench soil interface was studied. The effect of physical clogging, using bentonite as a clogging agent, also was investigated. The test section consisted of a 2' x 2' x 24' long box containing a standard trench placed in graded sand. Discharges from this section were measured at one foot intervals along the length of the section. Piezometer readings gave the depth of water at one foot intervals along the trench. Conclusions were: (1) For the conventional system using standard products for the distributor, the effluent was distributed over at most 7 feet of the trench. (2) For dosing chamber tests using dose volumes recommended by P.H.S., a distinct unbalance in the distribution resulted. (3) Uniform distribution could be obtained using a dose volume of approximately 200% of the inside volume of the distributor. (4) Physical clogging tests showed the conventional system outlasting the dosing system by approximately 30%. This condition was proven mathematically and logically. (5) A level trench bottom would provide for maximum utilization of the field regardless of flow type or slope of distributor pipe. (Santeford-Mich Tech)
W69-00217

5F. Water Treatment and Quality Alteration

AN INVESTIGATION OF ALTERNATIVE MEANS OF ACHIEVING WATER QUALITY OBJECTIVES,
Oregon State Univ, Corvallis.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00346

SENSITIVITY ANALYSIS OF ACTIVATED SLUDGE ECONOMICS,
Stanford Univ, Stanford, Calif.
For primary bibliographic entry see Field 06C.
For abstract, see .
W69-00352

5G. Water Quality Control

SANITARY WATER BD V MUNICIPAL AUTH (ADMINISTRATIVE POLLUTION ABATEMENT).
State of Pennsylvania, Harrisburg.

79 Dauph 316-323 (Pa Com Pl 1962).

Descriptors: *Pennsylvania, Judical decisions, *Administrative decisions, Administrative agencies, Water pollution control, Water quality control, *Pollution abatement, Water law, Water permits.
Identifiers: *Water Sanitary Board.

The case involves an appeal from an order of the Pennsylvania Water Sanitary Board ordering the New Oxford Municipal Authority to discontinue the discharge of treated sewage effluent into an unnamed tributary and to construct an outfall sewer elsewhere. Under section 207 of the Pennsylvania Clean Streams Law of 1937, P S 691.207, plans for new sewer systems and extensions of old ones must be submitted to and approved by the Board. Constructions nut approved or maintained in accordance with the rules and regulations of the board, are declared to be an abatable nuisance. Pollution, as defined by the statute, may also be abated by the Board. The court in the instant case rejected the Authority's challenge to the Board's order that the evidence upon which the Board based its findings and conclusions was insufficient. (Patterson-Fla)
W69-00013

INFLUENCE OF TIME AND PRECIPITATION ON CHEMICAL COMPOSITION OF SPOIL DRAINAGE,
Ohio Agricultural Research and Development Center, Wooster, and U. S. Corps of Engineers, Cincinnati.
J. P. Vimmerstedt, and P. H. Struthers.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 152-163, May 1968. 12 p, 1 tab, 11 fig, 4 ref.

Descriptors: *Acid mine water, *Leaching, *Lysimeters, *Spoil banks, *Acidic soils, Strip mines, Model studies, Weathering, Rainfall, Sulfates, Ohio.
Identifiers: Experimental soil leaching, Leachate, Spoil drainage.

An experimental strip mine spoil-leaching study to identify and measure the chemical products of spoil weathering was initiated 9 years ago in Ohio. Coal mine spoil is leached in 1 foot diameter lysimeter tubes, 4 feet deep, under natural climatic conditions. Each year's leachate is collected and analyzed for concentrations of total soluble salts, sulfate, calcium, magnesium, iron, aluminum, and manganese. The spoil sources were assigned to 4 general classes: toxic, with a pH less than 4.0 on over 75% of the outcrop area; acid, with pH of 5.0-6.9 on 50% of the area; marginal, with pH below 4.0 on 50-75% of the area; and calcareous, with pH over 7.0 on over 50% of the area. The amount of leachate and the weight of salts leached followed the same general trend as rainfall, but the total amounts of pyrite oxidation and weathering of other minerals per unit precipitation decreased with time. Toxic and marginal spoils yielded about 100 times more Fe, Al, and Mn, and 5 times more total salts than calcareous and acid spoils. Where toxic and marginal spoils are exposed, their high potential for acid and salt production must be recognized and extra care should be taken to minimize erosion and runoff and maximize infiltration. (Knapp-USGS)
W69-00092

AN EVALUATION OF FACTORS AFFECTING ACID MINE DRAINAGE PRODUCTION AND THE GROUND WATER INTERACTIONS IN SELECTED AREAS OF WESTERN PENNSYLVANIA,
Pennsylvania State University, Department of Geology and Geophysics, University Park.
Frank T. Caruccio.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 107-151, May 1968. 45 p, 11 tab, 13 fig, 22 ref.

Descriptors: *Acid mine water, *Acid bacteria, *Environmental effects, *Hydrogen ion concentration, *Calcite, Inhibition, Water quality, Groundwater, Pennsylvania.
Identifiers: Calcite-pyrite intergrowths, Acid potential, Alkaline waters.

A laboratory and field study was undertaken to find the differences between acid and non-acid strip mines, to determine the acid potential of rocks with varying sulfur content, and to correlate various factors in acid drainage, including regional water quality, regional rock type, and interactions between acid mine drainage and natural waters. Strip mines in the Clearfield area, which are underlain by acid-producing 'marine-brackish' Lower and Middle Kittaning Formations, and in the Glen Richey area underlain by non-acid-producing 'fresh-water' Freeport strata were studied. The most critical factor in acid water production is the presence of calcium carbonate; alkaline waters will abate the acidity. Bacteria catalyze pyrite oxidation, but grow only in a limited low pH range; alkaline waters sterilize the environment. Once bacteria contaminate a mine, they can produce enough acid to overcome carbonate inhibition. Bacterial generation of acid mine waters is self propagating. The difference in acid production in the 2 areas studied is possibly that pyrite in the Glen Richie area contains enough admixed calcium carbonate to prevent acid bacteria; whereas pyrite in the Clearfield area does not. (Knapp-USGS)
W69-00095

REDUCTION OF ACID PRODUCTION IN COAL MINES WITH USE OF VIABLE ANTI-BACTERIAL AGENTS,
MSA Research Corp, Division of Mine Safety Appliances Company, Evans City, Pa.
R. E. Shearer, W. A. Everson, and J. W. Mausteller.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 98-106, May 1968. 9 p, 5 fig, no ref.

Descriptors: *Acid bacteria, *Acid mine water, *Inhibitors, *Biocontrol, *Bacteriophage, Bactericides.
Identifiers: Parasitic bacteria, Caulobacter, Antibiotics (Bacterial).

Laboratory studies involving passage of water through piles of coal show that bacterial acid production can be reduced by factors as high as 30 with 3 inoculations in 6 months of natural anti-bacterial agent found in some non-acidic mines. Concentrated anti-bacterial cultures were developed on solid media; similar techniques might be used in liquid media to produce large quantities of culture of mine dosing. The nature of the anti-bacterial agent is unknown. No phages were seen with the election microscope, but washing with distilled water in sampling may have destroyed them. The inhibitor may be a competition effect from Caulobacter, which was observed in inhibited cultures and may have either obstructed the access of acid bacteria to their nutrient or acted as a parasite. Antibiotics produced by other organisms may be involved. (Knapp-USGS)
W69-00097

AN EXPERIMENTAL STUDY OF FERROUS IRON IXIDATION IN ACID MINE WATER,
U. S. Bureau of Mines, Pittsburgh Mining Research Center, Pittsburgh, Pa.
Ann G. Kim.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 40-45, 1968. 6 p, 3 fig, 2 ref.

Descriptors: *Acid mine water, *Waste water treatment, *Oxidation, *Iron, *Aeration, Chemical oxygen demand, Iron bacteria, Sulfides, Sulfates.
Identifiers: Ferrous iron oxidation.

Samples of natural mine water were studied to determine the effect of aeration upon the rate of oxidation. The rate of oxidation of ferrous iron in an acid environment depends upon the concentrations of ferrous iron and dissolved oxygen, and upon the temperature. Eight 1-liter samples were used for each test. Four samples were aerated at rates of 200 cubic centimeters per liter per minute and 2,000 cubic centimeters per liter per minute; 2 were in open containers to allow normal oxygen diffusion from the air into the water and 2 were in closed containers with dissolved oxygen originally present in the water. Aeration was found to have no beneficial effect upon a low ferrous iron water (34 ppm) because the water had an adequate amount of dissolved oxygen. It did decrease the time necessary for complete oxidation in waters with 175 to 260 ppm ferrous iron, evidently by keeping the water saturated with dissolved oxygen. (Knapp-USGS)
W69-00099

INVESTIGATION PROGRAM FOR AQUIFER PROTECTION REQUIREMENTS, CHICAGOLAND DEEP TUNNEL PLAN,
Harza Engineering Company, Water Resources Planning Division, Chicago, Ill.
I. S. Papadopulos, and R. E. Aten.
Ground Water, Vol 6, No 3, pp 4-9, May-June 1968. 6 p, 2 fig, 3 ref.

Descriptors: *Sewage disposal, *Runoff, *Tunnels, *Injection wells, Model studies, Permeability, Illinois, Rainfall intensity, Aquifers, Water quality, Water storage, Groundwater, Analog models, Sewers, Exploration.
Identifiers: *Aquifer protection, *Chicago, Pumping tests, Injection tests.

A study is described of requirements for aquifer protection in connection with Chicago's Deep Tunnel Plan for Flood and Pollution Control being implemented by the Metropolitan Sanitary District. Plans call for temporary storage of combined sewer overflows in a system of tunnels about 800 ft below the city. The same sewer system is used for municipal waste and surface drainage. When rainfall intensity is over 0.1 in. per hr, the system now overflows and raw sewage enters streams. Proposed controls include separate sewer systems, concentric sewer-pipe systems, shallow holding tunnels, and the deep tunnel plan, which is considered the best and most economical. Favorable tunnel location is in the Galena-Platteville dolomite, which contains the aquifer that must be protected from contamination. Electric analog studies using available data show that protection can be provided by operating recharge wells so as to maintain continuous flow into the tunnels. Recent studies include detailed exploratory drilling, aquifer test, pumping tests in the zone to be tunneled, injection tests, and an analog model analysis for showing future effects of the tunnels and recharge operations. (Knapp-USGS)
W69-00106

MINE AIR SEALING: A PROGRESS REPORT,
Bureau of Mines, Dept. of the Interior, Pittsburgh Mining Research Center.
Noel N. Moebs.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 255-264, May 1968. 10 p, 8 fig.

Descriptors: *Acid mine water, *Mine drainage, *Pollution abatement, *Model studies, *Research and development, Coal mines, Pennsylvania.
Identifiers: *Coal mine sealing, Air sealing, Upper Freeport coalbed.

A small, abandoned above drainage coal mine in the Upper Freeport coalbed in western Pennsylvania, which discharges acid water, was air sealed in 1966 to determine if the acidity and iron of the discharge could be reduced. The geologic and hydrologic environment of the mine were investigated to aid in evaluating the effectiveness of air sealing and indicate the controlling factors. Ground water level, quality, and composition of the overburden were obtained from drill holes. The atmosphere in the sealed mine was sampled periodically, and the differential air pressure across the seal was recorded. The flow rate fluctuates between 6 and 632 gpm. About 30 percent of the total annual precipitation over the 77-acre area percolates downward into the mine. The water table over most of the mined area has been depressed as a result of mining, and some springs and wells on the property were lost during mining. Water pH remained between 3.0 and 3.5 for the duration of the experiment, and total iron decreased slightly, as has the total acidity. For the first 19 months after sealing there was no significant improvement in the quality of the mine effluent which could be attributed to sealing, other than a decrease in variance. (Knapp-USGS)
W69-00116

SOME CHARACTERISTICS OF DRAINAGE FROM DEEP BITUMINOUS MINES IN WESTERN PENNSYLVANIA,
Pennsylvania Department of Health, Harrisburg, Div. of San. Eng.
Grover H. Emrich, and D. R. Thompson.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 190-222, May 1968. 33 p, 52 fig.

Descriptors: *Mine drainage, *Coal mines, *Bituminous materials, *Acid mine water, *Water quality, Acidity, Alkalinity, Water quality control, Standards, Pennsylvania.
Identifiers: Bituminous coal mine drainage.

Data on quality and quantity of deep bituminous coal mine drainage water (in western Pennsylvania) are compiled and presented on maps. The quality data are mapped in simplified form and percentages of mines with acid water are compiled for each county. Numbers of mines with acid, alkaline, and no discharge are also given by county. In general, the younger coal seams (Sewickley-Pittsburgh) have more alkaline discharges and the older seams (Clarion-Brookville) have acid discharges. Several seams vary regionally in discharge quality. Sewickley and Pittsburgh are alkaline in the southwest counties because of the presence of larger, proportions of limestone, and more acid north and east where there is less limestone. There is a low-acidity band in Clearfield, Armstrong, and Indiana counties in the Lower Freeport Seam; to the northwest and southeast, discharges are acid. (Knapp-USGS)
W69-00121

MIGRATION OF BACTERIOPHAGE T4 IN PERCOLATING WATER THROUGH SELECTED OAHU SOILS,
Hawaii Univ., Honolulu.
Richard M. Tanimoto, Reginald H. F. Young, and Nathan C. Burbank, Jr.
OWRR Project No. A-001-HI, Water Resources Research Ctr, Tech Rpt No 20, Jun 1968. 45 p, 9 fig, 4 tab, 64 ref.

Descriptors: *Viruses, *Bacteriophage, Percolation, Ground-water, Water pollution.

Tests to determine the ability of three Oahu soils to remove the coliphage T4Br11 mutant virus from water percolating through low humic latosols (Wahiawa and Lahaina soils) proved the soils ability to retain the virus but only at depths greater than 21/2 inches. Absorption was 100% when the concentration applied was 2.5 x 10 to the 6 power virus per ml of feed solution. Breakthrough at lesser thicknesses of soil occurred slowly at first then increased rapidly with time. Tantalus tuff, a cindery pumice substratum was ineffective in retaining viruses even at soil thicknesses of as great as 15 inches. (Burback-Hawaii)
W69-00225

EXCESS BENEFIT,
Virginia Univ, Charlottesville.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00228

NEW JERSEY WATER PROBLEMS AND PLANNING,
American Water Works Assoc, New York.
R. J. Hughes.
J Amer Water Works Assoc, Vol 59, No 4, pp 1209-1212, Oct 1967. 4 p.

Descriptors: *New Jersey, Water pollution, Air pollution, Pollution abatement, Sewage treatment, Delaware River Basin Commission, River systems, River basin development, Planning, Project planning, Legislation, State governments, Political aspects, Education.
Identifiers: Regional approach (Planning).

In an address to the American Water Works Association's annual conference, Governor Hughes of New Jersey, gives a broad overview of New Jersey's water problems and its projects in the area. He covers the need for water in the northeast portion of the state, water pollution and control, sewerage facility planning, the establishment of a Clean Water Council, and the regional approach to solving water problems through the Delaware River Basin Commission.
W69-00282

GUIDELINES FOR ESTABLISHING WATER QUALITY STANDARDS FOR INTERSTATE WATERS.
Federal Water Pollution Control Admin., Washington, D. C.

Guidelines for Establishing Water Quality Standards for Interstate Waters, pp 1-10, Jan 1967. 10 p.

Descriptors: *Pollution abatement, *Water policy, *Water Quality Act, *Administration, Water law, Administrative decisions, Federal government, State governments, Watercourses (Legal), Interstate, Interstate rivers.
Identifiers: Water Pollution Control Act, *Interstate waters, Department of the Interior.

The Federal Water Pollution Control Act, as amended by the Water Quality Act of 1965, provides for the establishment of water quality standards for interstate waters. Unless a state adopts water quality criteria and plans for implementing them, and they are approved by the Secretary of the Interior, the Secretary is authorized to establish them. This paper purports to present guidelines for developing water quality criteria and plans for implementing and enforcing them, and to delineate factors which the Secretary will consider in approving a state's actions in this matter. The primary guidelines are found in the Federal Water Pollution Control Act, the Water Quality Act of 1965, and legislative history. Conservation values must be considered under this legislation. A cornerstone of the policy guidelines, which are set forth in considerable detail, is that no one has the right to pollute. Discharge of untreated wastes into interstate streams should be eliminated under a State's plans. The term 'interstate waters', which defines the coverage of legislation behind the standards, is amplified. Means of obtaining cooperative assistance from the Federal Water Pollution Control Administration are outlined.
W69-00284

THE ECONOMICS OF REGIONAL WATER QUALITY MANAGEMENT: WATER POLLUTION AND RESOURCES ALLOCATION BY PRIVATE MARKETS,
Allen V. Kneese.
Baltimore, Johns Hopkins Press, 1964. p. 38-53.

Descriptors: *Water allocation (Policy), *Water pollution control, *Economic efficiency, *Damages, Costs, Cost sharing, Administration, Decision making, Diseconomies of scale, Water pollution effects, Water pollution treatment, Water rights, Remedies, Upstream, Downstream, Water users, Water shortage, Water law, Technology.

Most economists consider the market system as an efficient device for allocating resources pursuant to consumer wants. Water pollution is a classic example of technological external diseconomy. One key to the pollution problem is the failure of municipal and industrial waste dischargers to consider that subsequent water uses may be made more expensive or foreclosed entirely by the discharge. The results are higher costs of treatment and increasing wastes. There is a close relation between the nature of property rights and the occurence of external diseconomies. Property rights should be structured such that upstream polluters will take into account downstream costs. Legal remedies are inadequate in several respects. The possibility of internalizing the externalities into a private decision making unit over an entire basin is discussed. The relationship of upstream discharges and downstream damages is also discussed. Downstream costs must be measured against upstream depletion reduction. Consideration of water shortages involve the same principles. The market place and judicial system do not automatically result in realization of downstream damages.
W69-00286

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THE ECONOMICS OF REGIONAL WATER QUALITY MANAGEMENT: NATURE OF THE PROBLEM,
Allen V. Kneese.
Baltimore, Johns Hopkins Press, 1964. p 3-34.

Descriptors: *Water quality, *Water pollution, *Pollutants, *Water pollution treatment, Water quality control, Institutions (Planning and organizational agencies), Pollutant identification, Biochemical oxygen demand, Technology, Water pollution effects, Waste dilution, Artificial recharge, Recirculated water, Desalination, Regulated flow.

Despite the great interest in the problem of water quality and recent pollution control efforts, serious problems still exist and action by economists and public administrators is needed. Water quality management raises questions as to the determination of water quality, the systems to achieve that quality, and the institutions to administer that quality. Pollutants can be categorized as degradable and nondegradable. The measurement of degradable organic wastes and the rate of waste degradation presents technical problems. One measure is biochemical oxygen demand, BOD. Automatic monitoring is becoming more widespread. There is less certainty in the water environment field than most other scientific fields. Water quality may be improved by treating wastes or by increasing dilution. Methods of treating waste water are described. Water supply treatment is similar in nature. Other treatment subjects include direct recirculation, desalinization, divided distribution systems, and artificial recharge. Dilution of wastes may be accomplished by alteration of either the pattern of streamflow or waste discharge. This section concludes with considerations of economic factors and administrative decision-making processes.
W69-00287

WATER SUPPLY AND POLLUTION CONTROL ASPECTS OF URBANIZATION,
Duke Univ., Durham, N. C., School of Law.
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00290

FEDERAL AIR AND WATER CONTROL: THE APPLICATION OF THE COMMERCE POWER,
George Washington Univ., Washington, D. C.
Sidney Edelman.
George Washington L Rev, Vol 33, No 5, pp 1067-1087, June 1965. 21p, 122 ref.

Descriptors: *Air pollution, Impaired water quality, Public health, *Water pollution, Pollution abatement, *Water pollution control, Control, Federal government, Interstate, Water law, Clean Air Act, *Federal jurisdiction, Judicial decisions, Water rights, Legislation, Jurisdiction, State governments, Legal aspects, Navigable waters.
Identifiers: Constitutional law.

The federal commerce power is analyzed on the basis of its application to air and water pollution. Federal statutes designed to allow the Attorney General to bring court actions to secure abatement of both interstate and intrastate pollution are discussed. The constitutional basis for the exercise of such power is given primary emphasis. The issue is not difficult when pollution is interstate. Control fits clearly within the confines of the commerce power. When intrastate water pollution takes place in a navigable stream, the basis of federal control is considered similarly clear. Federal jurisdiction over intrastate air pollution rests on the fact that such pollution affects interstate commerce, or obstructs the navigable air space. It is concluded that the same principles which serve as a basis for congressional authority to protect navigable waters as highways of interstate commerce are applicable to navigable air space.
W69-00291

NOR ANY DROP TO DRINK: PUBLIC REGULATION OF WATER QUALITY PART I: STATE POLLUTION CONTROL PROGRAMS,
U of Iowa College of Law, Iowa City, Iowa.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00335

WATER POLLUTION - ATTEMPTS TO DECONTAMINATE FLORIDA LAW,
U of Florida, Gainesville, Florida.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00336

INDUCED RAPID RELEASE AND UPTAKE OF PHOSPHATE BY MICROORGANISMS,
Minnesota Univ., Minneapolis, Limnological Research Center.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00389

MINE WATER RESEARCH: THE LIMESTONE NEUTRALIZATION PROCESS,
Bureau of Mines, Department of the Interior, Pittsburgh, Pa.
E. A. Mihok, Maurice Deul, C. E. Chamberlain, and J. G. Selmeczi.
U. S. Bureau of Mines Report of Investigations 7191, September 1968, 20 p, 14 fig, 7 tab, 3 dwg, 6 photo, 3 chart, 6 ref.

Descriptors: *Neutralization, *Limestones, *Acid mine water, *Water pollution treatment, Acidity, Alkalinity, Carbon dioxide, Chemical precipitation, Aeration, Oxidation, Sedimentation, Slurries, *Particle size, Water chemistry, Carbonates, Acidic waters, Autogenous grinding.
Identifiers: Stream improvement, Pollutants, Water quality, Reclaimed water, Mine water.

A pilot plant for treating mine drainage by neutralization with limestone was designed, fabricated, and operated. The process produces a very fine (minus 400-mesh) limestone slurry in a tube mill, mixes the slurry with mine water, aerates mixture to remove carbon dioxide and precipitate iron, and separates solids from the liquid by sedimentation. Water of pH 2.8, 1,700 ppm total acidity, 36 ppm ferrous iron, and 360 ppm iron, was treated at rates of 300 to 400 gpm and ultimately reached a pH of 7.4 and contained no detectable iron. The sludge compacted to one-third the volume from mine water neutralized with lime. The advantages of the limestone process are wide distribution and low cost of limestone, simplicity, reduction of hazards and of operating and maintenance costs by use of a less reactive agent, higher solids concentration in the sludge, and no deleterious effect caused by overtreatment. Cost of treating mine water by the limestone process is at least one-third to one-half the cost of the lime process. (Mihok-Bur Mines)
W69-00397

06. WATER RESOURCES PLANNING

6A. Techniques OF Planning

OPTIMIZATION METHODS IN WATER RESOURCES PLANNING,
Missouri Univ., Columbia, Department of Agricultural Economics.
Oscar R. Burt.
Florida Univ, Institute of Food and Agr Sci, Water Research Needs: An Economic Appraisal, Pub No 3, pp 75-85, Dec 1967. 11 pp, 17 ref.

Descriptors: *Linear programming, *Dynamic programming, *Systems analysis, Water resources development.
Identifiers: Economics, *Mathematical studies, Planning.

Three optimization techniques were discussed, mathematical (linear) programming, dynamic programming, and simulation. Mathematical programming is comprised of an objective function of several variables which is maximized subject to a set of constraints on the variables. The mathematics of dynamic programming permit estimation of conditional decision rules or strategies that optimize an expected value criterion function. The only requirement is that the dependence relationship of the process be markovian from stage to stage (time period to time period). Simulation is used as a device to calculate an observation on the objective function for given magnitudes of certain decision variables. Given the decision variables, the objective function is a random variable whose probability distribution is specified in the simulation model. The ultimate objective of the research is to explore the mean of the objection function as it is related to the decision variables. The applicability of the three optimizing techniques to water resource problems was also discussed. (Grossman-Rutgers)
W69-00169

WHEN IS IT SAFE TO EXTEND A PREDICTION EQUATION -- AN ANSWER BASED UPON FACTOR AND DISCRIMINANT FUNCTION ANALYSIS,
Department of Agriculture, Forest Service, Berkeley, California.
James R. Wallis.
Water Resources Research, Vol 3, No 2, pp 375-384, Second Quarter 1967. 10 p, 2 fig, 5 tab, 10 ref, 2 append.

Descriptors: *Estimating equations, *Forecasting.
Identifiers: *Linear discriminant function, *Uncertainty categories, Factor analysis, Prediction, Stepwise procedures, Relevance.

Prediction equations for hydrologic events developed from one population of observations (Watersheds) are often solved for another population that is removed either in time or in space. Predictions of this kind are never certainties, although some predictions are obviously more uncertain than others. This paper proposes an empirical uncertainty classification that may be found useful for separating probably successful from probably unsuccessful extensions of prediction equations. The classification system is illustrated by a prediction equation for suspended sediment discharge developed from some watersheds in California, and by a discriminant function for marine versus nonmarine sediments based upon microelements. (Seneca-Rutgers)
W69-00200

SIMULATION OF GREAT LAKES BASIN WATER SUPPLIES,
U. S. Lake Survey, Detroit and Inland Waters Branch, Ottawa, Canada.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-00201

AUTOCORRELATION AND SPECTRAL ANALYSIS IN HYDROLOGY,
Pittsburgh Univ., Pittsburgh, Pennsylvania.
Rafael G. Quimpo.
Proc Amer Soc Civil Eng, J Hyd Div, Vol 94, No HY2, pp 363-373, March 1968. 11 p, 4 fig, 23 ref, 2 append.

Descriptors: Time series analysis, Markov processes, Fourier analysis.
Identifiers: *Autocorrelation, *Spectral analysis, Correlogram, Spectral density, Boise River, Serial correlation coefficients.

Forty years of daily flow records of a river are analyzed using autocorrelation and spectral

techniques. The two methods of analysis are compared relative to costs or effort and extracted information. For statistical prediction, autocorrelation is shown to be more economical. The discriminatory power of the spectral density function, which allows the detection of noncommensurable harmonics, did not carry much weight for the time series studied. A reduction in calculations can be achieved by examining the behavior of the correlogram only in the vicinity of suspected periods. In modeling, autoregressive techniques may be readily extended to the multivariate case. The intended use of the results is also a factor in the choice of methodology in data analysis. (Seneca-Rutgers)
W69-00207

FINDING RESERVOIR OPERATING RULES,
Federal Water Pollution Control Admin, Washington.
George K. Young, Sr.
Proc Amer Soc Civil Eng J Hyd Div, Vol 93, No HY6, pp 297-321, November 1967. 25 p, 2 fig, 4 tab, 24 ref, 2 append.

Descriptors: *Economic efficiency, *Reservoirs, Dynamic programming, Model studies, Monte Carlo method, Least squares method, Queueing theory, Forecasting, Regression analysis.
Identifiers: *Operating rules, *Optimal policies, *Dynamic programming algorithms, Expected loss, Linear decision rules.

Deterministic dynamic programming is used with operational hydrology to find optimal reservoir operating rules. The objective is to find that annual operating policy of a single reservoir having an economic loss associated with each draft rate which minimizes the expected loss. (Seneca-Rutgers)
W69-00209

OPTIMIZATION OF THE OPERATION OF A MULTI-PURPOSE RESERVOIR BY DYNAMIC PROGRAMMING,
California Univ, Los Angeles.
Warren A. Hall, William S. Butcher, and Austin Esogbue.
Water Resources Research, Vol 4, No 3, pp 471-477, June 1968. 7 p, 3 fig, 4 ref.

Descriptors: *Dynamic programming, *Multiple-purpose reservoirs, *Optimum development plans, Prices, Optimization, Reservoirs, Linear programming, River systems, California, Constraints, Risks, Planning.
Identifiers: Multiple-river systems, Shadow prices, Objective function, Maximum return.

A technique of analysis is presented by which the dynamic operation policies for planning complex reservoir systems producing hydroelectric power and providing water can be optimized for the maximum return from firm water, firm power, dump water, and dump power. The technique provides for complex constraints, such as mandatory flood control reservations variable in time, fish, wildlife, and recreational releases, navigation minimum flows, etc., as well as evaporation losses and interbasin diversions. The paper presents in detail the operational analysis of a component reservoir-river system and the procedure to be used to combine optimally a number of such sub-systems into a coordinated, mutually reinforcing, multiple-river system. (Seneca-Rutgers)
W69-00219

FACTOR ANALYSIS IN HYDROLOGY - AN AGNOSTIC VIEW,
IBM Watson Research Center, Yorktown Heights, N Y.
James R. Wallis.
Water Resources Research, Vol 4, No 3, pp 521-527, June 1968. 7 p, 3 tab, 23 ref, 1 append.

Descriptors: Regression analysis.
Identifiers: *Factor analysis, *Antifactor analysis, Predictors, Reduced rank regression, Varimax rotation, Model building.

It is suggested that factor analysis, if used in the classical manner, will never be of great value for hydrologic analysis. However, factor analysis used as a numerical procedure for screening variables and building effective regression equations is a useful and powerful tool for hydrologic analysis that can be expected to yield equations that outperform others when they are used as predictors for control samples. (Seneca-Rutgers)
W69-00220

TOTAL MANAGEMENT OF WATER RESOURCES,
American Water Works Assoc, New York.
R. L. Smith.
J Amer Water Works Assoc, Vol 59, No 4, pp 1335-1339, Nov 1967. 5 p.

Descriptors: *Future planning (Projected), Federal government, State government, Political aspects, Social aspects, Planning, *Water utilization, Water resources development, Administration, Water management (Applied).
Identifiers: *Total management.

The author explores the concept of 'total management' as it relates to water development. He points out the need for total management in all areas connected with water. Before total management can come about, however, there must be a new organization established to administer it. The structure of the organization must be based on economic, institutional, jurisdictional and hydrologic conditions. Total management must be oriented toward planning, responsive to subjective values as well as to purely environmental factors, careful to avoid commitment to possibilities that may not materialize, and continually in search of new technology.
W69-00281

SCALING OF ATTITUDES TOWARDS WATER CONSERVATION,
Florida Univ., Gainesville, Department of Sociology.
George A. Watkins.
OWRR Project No. A-010-Fla., Master of Arts Thesis, December, 1968. 101 pp, 18 tab, 17 ref, 4 append.

Descriptors: *Attitudes, Water conservation, *Socioeconomic variables, Water use, Appliances, West Palm Beach, Fla., Education.
Identifiers: *Scalogram analysis, Non-parameteric statistics, Factor analysis, Guttman scale, Urban families, Water resources problems.

An attitudinal scale was developed that might be useful to social and natural scientists and to civil engineers concerned with the water resources problem. Carried out as part of the Water Resources Research Project at the University of Florida, the data utilized were collected by interviews with 313 residents of Palm Beach County, Florida. The interview schedules elicited specific socioeconomic information and attitudes, the latter within four subuniverses. Using the technique of Guttman scalogram analysis, the scale had an acceptable coefficient of reproducibility. To validate the four subuniverses, the attitudinal items were subjected to a factor analysis. The scale scores were then compared with the socioeconomic variables using the techniques of the Spearman rank correlation of coefficient and the Kruskal-Wallis one-way analysis of variance. Such a comparison revealed, using null hypotheses, the nature of the relationship between respondents' attitudes and their actual involvement in the water resources problem. (Author)
W69-00312

A WATER RESOURCE MODEL,
Stanford Univ, Palo Alto, California.
Frederick S. Hillier, and Gerald J. Lieberman.
Introduction to Oper Res, Holden Day, Inc, pp 423-425, 1967. 3 p.

Descriptors: *Markov process, Multipurpose reservoirs, Mathematical model, Linear programming.

A mathematical model was presented for a hypothetical multipurpose dam. The basic assumption made was that the probabilities of inflows into the reservoir constitute a Markov chain with positive recurrent states which belong to one class. By taking advantage of the steady state properties of this statistical process, a solution to the optimal release policies was suggested. Stochastic linear programming was suggested as one applicable technique for solution. (Gablinger-Cornell)
W69-00341

SIMULATION TECHNIQUES FOR DESIGN OF WATER-RESOURCE SYSTEMS,
Maynard M. Hufschmidt, and Myron B. Fiering.
Simulation Tech Design Water-Resource Systems, Harvard Univ. Press, Cambridge, Mass., 1966. 212 p, 51 fig, 14 tab, 42 ref, 2 append.

Descriptors: *Simulation analysis, Water resources development, *River basin development, Synthetic hydrology, Benefits, Costs, Digital computers, Monthly, Annual, Streamflow, Evaluation, *Economic efficiency, *Computer models, *Comparative benefits, Design.
Identifiers: Lehigh River system, Delaware River system.

The methodology of simulation was presented and applied to models of the Lehigh and the Delaware River systems. Alternative designs, such as structure sizes and target output levels were treated as input variables, which were arranged in various combinations. Hydrologic sequences were generated in order to economically test the performances of alternative designs. System costs and benefits, including economic losses arising from output deficits, were computed. Results were summarized in terms of net benefits for various interest rates and schedules of development. The methods were illustrated by an application to an actual case, the Lehigh River. The problems of model validation were discussed. An extension of the simulation technique developed for the Lehigh to the larger Delaware system was reported. Fortran routines and study results were shown in figures and tables. (Gysi-Cornell)
W69-00342

THE ROLE OF COMPUTERS IN PLANNING AND MANAGING WATER UTILITIES,
Harvard Univ, Cambridge, Mass.
Joseph J. Harrington.
J New England Water Works Ass, Vol 81, No 3, pp 231-257, Sept 1967. 27 p, 9 fig, 2 tab, 18 ref.

Descriptors: *Analytical techniques, *Digital computers, Economic efficiency, Hydraulic design, Linear programming, Dynamic programming, Mathematical models, *Planning, *Utilities, *Water management (Applied), Systems analysis optimization, Network design, Distribution systems.
Identifiers: Newton-Raphson method, Geometric programming, Dual variable.

The role of the digital computer in the planning and management of water utilities was discussed, and several hypothetical examples of programming methods were presented. The Newton-Raphson technique was used to solve for the flows in a simplified hydraulic network. A linear programming model of a production process was developed to find the optimum output for a manufacturer. The importance of the dual variables was discussed, and the dual problem was structured for the above example. The theory of geometric programming was summarized and applied to the design of a sedimentation basin. An example of a water-meter replacement program solution using dynamic programming was given. Procedures and results of the

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examples were demonstrated in tables and figures. (Gysi-Cornell)
W69-00344

TOWARDS ECONOMIC EVALUATION OF WATER QUALITY IN IRRIGATION,
Harvard Univ, Cambridge, Mass; Colorado State Univ, Ft. Collins.
D. Yaron, and E. Bresler.
Proc Int Conf Water For Peace, Washington, D C, Pap P/654, May 1967. 12 p, 2 fig, 1 tab, 13 ref.

Descriptors: *Linear programming, Salt balance, *Water quality, *Evaluation, Irrigation water, *Irrigation efficiency, Salinity, Chlorides, Salt tolerance, Soil properties, Marginal return, Leaching, Evapotranspiration, Soil water optimization.
Identifiers: Marginal substitutuion rate.

A linear programming model was developed and used to find the optimal combination of irrigation water quality and quantity. State variables, such as initial salt concentration of the soil, evapotranspiration rates, depth, and bulk density of soil layers, were assumed given. The salt concentration of irrigation water was the decision variable to be maximized, subject to maximum soil chloride concentration levels, and a continuity salt balancing constraint for the soil. The problem was repeatedly solved for various given irrigation rates. The results of a hypothetical example were tabulated and graphed. The individual solutions when plotted gave an 'iso-soil-salinity' curve for a maximum allowed soil salt concentration. It was concluded that the optimum point on the curve was that point where the marginal rate of substitution of water salinity for quantity just aqualled the unit cost rates of quantity increase to quality increase. (Gysi-Cornell)
W69-00345

AN INVESTIGATION OF ALTERNATIVE MEANS OF ACHIEVING WATER QUALITY OBJECTIVES,
Oregon State Univ, Corvallis.
Kenneth D. Kerri.
Ph D Thesis, Dept Civ Eng, Oregon State Univ, Corvallis, June 1966. 177 p, 26 fig, 23 tab, 47 ref, 3 append.

Descriptors: *Comparative costs, Computer programs, Dissolved oxygen, Coliforms, Economic efficiency, Constraints, Flow augmentation, Mathematical models, *Water quality control, Reservoir storage, Regression analysis, Waste assimilative capacity, *Waste dilution, *Waste treatment.
Identifiers: Non-linear programming, Willamette River Oregon.

Non-linear programming techniques were used to find the minimum cost of achieving various water quality objectives in the Willamette River Basin in Oregon. The objective of the study was to test the hypothesis that 'the waters of the Willamette are too costly for pollution abatement'. An analytical model consisting of two digital computer programs was developed. The minimum cost for removal of a certain quantity of BOD was obtained from a 'DO cost of treatment' matrix. That solution was inserted in the Streeter-Phelphs oxygen sag equation to predict the DO profile for the river. Regression analysis was used to compute costs of meeting coliform standards, and to determine costs of flow augmentation for waste dilution. All the studies were combined to find the minimum cost of treatment and storage to meet various quality standards and flow levels. Results in the form of the hypothesis acceptance or rejection were shown in tabular form. (Gysi-Cornell)
W69-00346

ON THE OPTIMUM RECORDING OF A TYPE OF HYDROLOGICAL DATA,
Delft Technological Univ, The Netherlands.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-00347

MANAGEMENT MODELS FOR WATER RESOURCE SYSTEMS,
Cornell Univ, Ithaca, N Y.
Daniel P. Loucks.
Tech Rep 1, Cornell Univ Water Resources Center, June 1967. 130 p, 18 fig, 8 tab, 241 ref.

Descriptors: Estimated benefits, Flow augmentation, *Linear programming, Probability, Economics, *Reservoir operation, River regulation, Seasonal, Stochastic processes, Mathematical models, *Water management (Applied), Water resources, *Water allocation (Policy), Optimization, Constraints, Oxygen sag.
Identifiers: Loss functions, Suboptimization.

Deterministic and stochastic linear programming models were structured and used to determine the reservoir releases and the allocations of water to each flow and stock use that meet some management objective. Three objectives incorporated into the model were: (1) max total expected net benefits; (2) min total expected net losses; and (3) min total expected deviation from each use's 'target' (if no economic benefit-loss data was available). Two deterministic linear programming models for water quality management were discussed. The models indicated the minimum cost required to maintain particular DO standards within the system, and the increase in costs resulting from any social, legal or administrative constraints. It was suggested that partial water quality control could also be achieved through appropriate allocations of water for wastewater dilution and transport. Extensions of the models and some economic implications were presented in the appendix. (Gysi-Cornell)
W69-00348

OPTIMUM OPERATION OF A MULTI-RESERVOIR WATER SUPPLY SYSTEM,
Stanford University, Stanford, California.
Reuven Amir.
Program in Eng Econ Planning, Stanford Univ, Rep EEP-24, May 1967. 129 p, 15 fig, 30 ref, 2 append.

Descriptors: Dynamic programming, *Reservoir operation, *Water supply, Water demand, Water costs, Water allocation (Policy), Variable costs, Stochastic processes.
Identifiers: Principle of Optimality.

A mathematical model for reservoir operation using the principle of optimality of dynamic programming was presented. A system of dams and conduits was assumed to exist. The inflows were assumed to be stochastic. Water demand was assumed a predetermined function of time. The objective was to avoid excess demand, considering the costs of shortage and operation. The decision variables were either reservoir levels or changes in reservoir levels. The state variables were the time left for the operation of the system, the amount of water stored in the reservoirs, and all the past inflows. The problem was analyzed as a single reservoir and as a generalized multi-reservoir system. Optimal policies were obtained under various simplified cost assumptions. (Gablinger-Cornell)
W69-00349

A SYSTEMS ANALYSIS OF THE LOWER GANGES-BRAHMAPUTRA BASIN,
Harvard Univ, Cambridge, Mass.
Peter Rogers.
Pap, UNESCO Int Symp on Floods and Their Computation, Leningrad, Aug 15-22, 1967. 26 p, 3 fig, 4 tab, 8 ref.

Descriptors: Systems analysis, Linear programming, Decision making, *River basin development, *International waters, Negotiations, Hydroelectric power, Irrigation, Salinity, Water policy, Navigable rivers, Flood control, Political constraints, Benefits, Optimum development plans.
Identifiers: India, East Pakistan, Ganges-Brahmaputra Basin, Game theory, Screening model.

A deterministic linear programming model was structured and used as a preliminary screening model of the Lower Ganges-Brahmaputra River Basin. The objective was to maximize the net returns from hydropower production and irrigation, subject to flood control, salinity, navigation system capacity and continuity constraints. The model was solved several times using adjustments on the constraint set to reflect various international policy decisions that could be considered by India and East Pakistan. The solutions to the various alternatives were then considered within the framework of game theory. The results were shown as a payoff matrix and as a geometrical representation of a co-operative two-person non-zero-sum game. It was concluded that the techniques of systems analysis could aid in determining guidelines for negotiation on river basin development at the international level. (Gysi-Cornell)
W69-00350

OPERATIONS RESEARCH APPLIED TO ENGINEERING PLANNING,
Tennessee Technological University, Cookeville.
For primary bibliographic entry see Field 06C.
For abstract, see .
W69-00351

AN OPTIMIZATION METHOD FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
Texas A and M University, College Station; University of Texas, Austin.
W. L. Meier, Jr., and C. S. Beightler.
Water Resources Res, Vol 3, No 3, pp 645-652, Third Quarter 1967. 8 p, 6 fig, 11 ref.

Descriptors: *Dynamic programming, River systems, Optimization, Planning, Mathematical models, Water resources, Correlation analysis, *Reservoir operation.
Identifiers: Serial systems, Branching.

Dynamic programming was used to structure a planning model of branching multistage nonserial water resources systems. Maximum return was obtained by decomposing the nonserial river basin system into equivalent serial systems. The use of this method involved introduction of a cut state at the junction between the branch and serial chain. The state variables were the cut states and the reservoirs storages, the decision variables were the releases from the reservoirs. A hypothetical example was solved. (Gablinger-Cornell)
W69-00353

RISK EVALUATION IN SEWAGE TREATMENT PLANT DESIGN,
Cornell Univ, Ithaca, N Y.
Daniel P. Loucks.
Amer Soc Civil Eng Proc, Vol 93, No SA 1, pp 25-39, Feb 1967. 15 p, 9 fig, 7 ref, 2 append.

Descriptors: Stochastic processes, Standards, Correlation analysis, Water policy, Digital computers, Diffusion, Dissolved oxygen, Economic efficiency, *Waste storage, *Mathematical models, Oxygen sag, Probability, *Risks, *Sewage treatment, *Evaluation, Water quality control, Design flow, Oxygen requirements, Constraints.
Identifiers: Probabilistic model, Transition probabilities, Plant design.

A Markov model was developed to predict, for any particular consecutive-day period, the probability of having less than any specified dissolved oxygen concentration downstream from a waste water treatment plant. The model allowed for both serial and cross correlation between average daily stream and sewage flow conditions. From the probabilities provided, the risk of violating of any stream standard or effluent standard could be determined. The probabilistic model was illustrated using a hypothetical example. Results of the model, including the effect of effluent storage on the cumulative probability distribution of minimum DO concentrations were shown. It was shown that the variability

of a stream's waste assimilative capacity might be used to advantage by means of effluent storage. Computer flow diagrams for determining the maximum allowable BOD concentration in a stream and for solving the model were appended. (Gysi-Cornell)
W69-00354

WATER QUALITY MANAGEMENT,
Univ of Oklahoma, Norman.
George W. Reid.
Water and Wastes Eng, Vol 4, No 11, pp 50-51, Nov 1967. 2 p, 1 fig.

Descriptors: Flow augmentation, Future planning (Projected), Input-output analysis, Mathematical models, Systems analysis, Water demand, *Water management (Applied), Water pollution, Water pollution treatment, *Water quality control, Stream improvement.
Identifiers: Nutritional chemicals, Persistent chemicals.

A brief history of some water supply shortage problems was given, and the use of pollution abatement as a first step towards increasing water supplies was suggested. Some of the fundamentals of water pollution were presented, including the various types of pollution usually encountered. Five equations that can be used for estimating required waste water treatment and streamflows for five different types of pollutants were given. The equations would be used as input-output transformations and would be integrated into a system and analyzed. A mathematical model for a single discharge waste and receiving stream was diagrammed. It was proposed that the approach to the solution of water resource availability be directed toward an optimal combination of waste treatment and low-flow augmentation from storage. (Gysi-Cornell)
W69-00355

A LEAST COST EVALUATION OF DISPOSAL SYSTEMS FOR LOW LEVEL LIQUID RADIOACTIVE WASTES,
Harvard Univ., Cambridge, Mass.
Walter O. Spofford, Jr., and Harold A. Thomas, Jr.

Oper Res Disposal Liquid Radioactive Wastes in Streams, Harvard Water Resources Group, Part 2, Dec 1967. 33 p, 7 fig, 5 tab.

Descriptors: *Radioactive waste disposal, Analytical techniques, Diffusion, *Economic efficiency, Liquid waste, Evaluation, Cost analysis, Mathematical models, Parametric hydrology, Reservoir storage, River flow, Waste water treatment, Waste storage, Water treatment, *Water quality control.
Identifiers: *Lagrange multipliers, Deterministic models, Steady state.

Lagrange multipliers were used in the analysis of a simplified waste handling and treatment scheme on stream. Deterministic steady state stream flows were assumed. The objective was to minimize the sum of the costs at an upstream waste treatment plant and a downstream water treatment plant. The water quality produced by water treatment plant was constrained to be greater than some value. The decision variables were the various combinations of efficiency for each of the plants, and the state variables were the physical and hydrologic parameters. Two examples, with and without assumed reservoir storage, illustrated the use of the model. Important concepts of systems analysis such as: (1) optimal economic design; (2) problem identification; (3) error analysis; and (4) optimal allocation of funds for future data collection were illustrated and discussed. One of five chapters in 'Operations Research in Disposal of Liquid Radioactive Wastes in Streams.' (Gysi-Cornell)
W69-00356

QUEUEING THEORY AND RESERVOIR DESIGN,
Harvard Univ, Cambridge, Mass.
Peter Watermeyer, and Harold A. Thomas, Jr.
Proc Harvard Symp Digital Computers and Thier Appl, Ann Comput Lab Harvard Univ, pp 59-76, Apr 1961. 18 p, 5 fig, 14 tab, 16 ref.

Descriptors: *Markov processes, *Reservoir operation, Reservoir design, Multiple-purpose reservoirs, Benefits, Linear programming, Optimization, Computers.

Stochastic linear programming was used to obtain an optimum operating policy connecting reservoir drafts with initial storages and flows. The objective was to maximize the expected value of benefits associated with various target drafts in various periods, subject to probability constraints. Serial correlation of the inflows was assumed and illustrated in probability matrices. The decision variables were the joint probabilities of an initial storage, inflow, and draft for any period. Two hypothetical examples illustrated the use of the model. The first example assumed one period per year, one benefit, and three possible flows. The second example assumed two periods per year, four possible flows, and three possible benefits. Results of the examples were shown in tabular form. (Gysi-Cornell)
W69-00357

A MODEL FOR DESIGNING WATER DISTRIBUTION PIPE NETWORKS,
Harvard Univ, Cambridge, Mass.
Ramachandran Pitchai.
Harvard Water Resources Group, Ph D Thesis, Harvard Univ, June 1966. 324 p, 42 fig, 25 tab, 79 ref, 9 append.

Descriptors: Digital computers, Design criteria, Design flow, *Distribution systems, *Economic efficiency, Estimated benefits, Estimated costs, Discount rate, *Hydraulic design, *Mathematical models, Pipes, *Network design, Pumping, Statistical methods, Water distribution (Applied), Water demand, Hydraulic properties.
Identifiers: *Non-linear integer programming, Sensitivity analysis.

Non-linear integer programming was used to find the optimum (least cost) design for the pipes in a water distribution system. The objective function to be minimized included pipe costs and the present value of annual pumping costs (both functions of the pipe diameters). The constraint set consisted of pipe friction formulas, Kirchoff laws, minimum permissible and commercially available pipe sizes, maximum permissible head losses, and pump characteristic curves. The network balancing algorithm was based upon the Newton-Raphson convergence method. Sequential random sampling techniques were applied to test system designs in the 'neighborhood' of an original 'reasonable' design. The use of a probabilistic approach for benefits was recommended. A sensitivity analysis on all the model parameters indicated that benefit and cost coefficients played an important role, and further research in their precise evaluations was recommended. (Gysi-Cornell)
W69-00358

TECHNIQUES FOR FINDING RESERVOIR OPERATING RULES,
Harvard Univ, Cambridge, Mass.
George Kenneth Young.
Ph D Thesis, Div Eng Appl Phys, Harvard Univ, Nov 1966. 89 p, 13 fig, 8 tab, 24 ref, 3 append.

Descriptors: *Dynamic programming, *Reservoir operation, Synthetic hydrology, *Simulation analysis, Markov processes, Streamflow forecasting, Optimization, Water allocation (Policy), Stability, Digital computers, Statistical methods, Water management (Applied), Regression analysis, Probability.
Identifiers: Target drafts, Loss function, *Deterministic, *Forward looking.

A deterministic, forward looking dynamic programming algorithm, together with hydrologic simulation, and regression techniques to find the optimal operating policy of a single reservoir. The objective was to minimize the sum of economic loss resulting from draft rates missing the target flow for an assumed maximum reservoir capacity. Other dynamic programming algorithms (backward-deterministic, and forward-and backward-stochastic) were discussed. A Gaussian lag-one Markov model was used to simulate inflows. The effect of the number of years studied on the first year draft decision was investigated. Optimal policies were obtained for various hypothetical loss functions. The policies were inferred by studying sequences of allocations resulting from the algorithm operating on simulated inflow sequences. A flow forecast model was derived, and used to investigate the value of inflow forecasts. It was concluded that the model was efficient for the objectives defined. (Gysi-Cornell)
W69-00359

6B. Evaluation Process

SOUTHWESTERN JEFFERSON COUNTY, KENTUCKY, FLOOD CONTROL PROPOSAL.
U. S. Army Corps of Engineers, Washington, D. C.

U. S. 90th Congr, 2d Sess, House Doc No 340, 80 p, 1968. 2 plate, 1 attach, 4 append.

Descriptors: *Recreation facilities, *Flood control, *Cost-benefit analysis, *Kentucky, Floods, Flood damage, Flood plains, Levees, Design criteria.
Identifiers: *Jefferson County, Kentucky, Louisville area, Flood Control Act.

Flooding in southwestern Jefferson County, Kentucky, was investigated and a plan for construction of local flood protection works, including an impoundment with recreational facilities, is presented. The area covers 41 sq miles of the Ohio River flood plain downstream from and contiguous to the existing flood control works of Louisville. Property worth $256,100,000 is in the overflow area. Future developments having a value of $409,300,000 are projected to 1975 without flood protection. Average annual flood damage now is $239,300. Levees and walls are the only practical flood protection. The planned works include an earth levee and a short concrete wall supplemented by 2 pumping plants and an 810 acre impoundment. The impoundment will be developed for recreation. Total first cost is $20,700,000, of which $14,050,000 is federal. Annual charges are $1,015,000 and benefits are $2,143,000, yielding a benefit-cost ratio of 2.1:1. Most of the annual benefits are recreational. (Knapp-USGS)
W69-00085

CLEAR CREEK, TEXAS, FLOOD CONTROL PROPOSAL.
U. S. Army Corps of Engineers, Washington, D. C.

U. S. 90th Congr, 2d Sess, House Doc No 351, 55 p, 1968. 1 plate, 1 attach, 4 append.

Descriptors: *Flood control, *Channel improvement, *Texas, Cost-benefit ratio, Floods, Flood damage, Design flood.
Identifiers: *Clear Creek, Texas, Flood Control Act, Spoil disposal.

Flood control plans for Clear Creek, Texas, about half way between Houston and Galveston, are presented. The 250 sq mi watershed of Clear Creek basin slopes from 70 to 5 ft above sea level. Parts of the cities of Houston, League City, Pearland, Friendswood, Brookside Village, and Webster are within its flood plain. Present flood control measures are not adequate. Floods result from intense local thunderstorms, general storms, and torrential hurricane rainfall. The value of property in the floodplain is $23,774,000. Based on growth projections, physical property values are expected to increase to about $427 million by 2070. A standard project flood under existing conditions of development would cause damages of $5,532,000; annual

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average damage is $578,000. The only feasible solution is channel enlargement and rectification to protect against the 100 yr flood. First cost is estimated to be $18,900,000 of which $12,600,000 is federal, and the benefit-cost ratio is 2.9. (Knapp-USGS)
W69-00087

COMPETITION FOR RECREATION WATER IN CALIFORNIA,
U. S. Army Engineer District, Sacramento, Calif.
Amalio Gomez, and Dale A. Crane.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR3, Pap 6109, pp 295-307, Sept 1968. 13 p, 2 fig, 3 tab, 5 ref.

Descriptors: *Multiple-use projects, *Reservoirs, *Recreation facilities, *Reservoir operation, *Water allocation (Policy), *California, Cost comparisons, Cost-benefit ratio, Water rights, Public benefits, Federal Project policy.
Identifiers: *Recreation water, *Water competition, Public demand, California Water Code.

Tremendous growth in recent years of water-oriented recreation has brought about great demand for minimum recreation pools and adequate facilities at reservoir projects. Water pools for recreation require acquisition of water to fill them initially and to compensate for added evaporation losses later. Such requirements are highly competitive with other established uses. This difficult problem was satisfactorily solved in 4 Federal reservoirs in a water-deficient area in California. Procedure used required a high degree of cooperation by water users, public at large, and construction agency. Required water for recreation was estimated at less than 0.5% of natural stream flow. Total cost, including storage, water, recreation facilities, and maintenance and operation is estimated at $0.30 per recreation-day. Under Public Law 89-72 about one half of this cost would be borne by the Federal Government and the other half by a local agency. Local costs can be financed through user fees. (Lang-USGS)
W69-00101

WATER NEEDS IN 1999,
Horner and Shifrin, Cons. Engr., St. Louis, Missouri.
Vance C. Lischer.
ASCE Journal of the Urban Planning and Development Division, Vol 93, No UP1, Proc Paper 5061, pp 13-20, Jan 1967, 8 pp.

Descriptors: Energy conversion, Plumbing, *Waste water disposal, *Water utilization, *Water re-use, *Resources, *Supply.
Identifiers: Forecasting, Conservation.

The paper is an expression of the writer's observations of trends in technology and water use by people and industry. It deals with these with respect to water and waste disposal practices which are expected to have an impact on water needs in 1999 and on the manner in which these needs are satisfied. Predictions into the future must recognize advancing technology, but must take into account that water-use habits are often tradition-bound, and are not always rational. (Grossman-Rutgers)
W69-00170

INSTITUTIONAL CONSTRAINTS AND ECONOMIC OPTIMA - A BASIS FOR MANAGEMENT DECISIONS IN INTRAREGIONAL WATER TRANSFER,
California Univ., Berkeley, California Agricultural Experiment Station.
C. Dick Detwiler.
Land Economics, Vol 44, No 2, pp 173-184, May 1968, 12 p, 17 ref.

Descriptors: *Water management (Applied), Pumps, Ground-water, Overdraft, *Water allocation (Policy), Legal aspects, *Political aspects, Cost-benefit analysis.
Identifiers: Economics, *Water transfer, *Institutional constraints.

This analysis emphasized the evaluation of political-institutional processes, legal structures, administrative techniques insofar as they effect the water economy. The ground-water overdraft problems of the Salinas Valley of California was the focal point of the analysis. A positive corrective action was called for, but the existing physical, institutional, and political environment of the area presented a strong constraint upon the efficiency implication of an optimal water policy. A traditional solution based on economic analysis of costs and benefits had to be qualified since: (1) an inefficient solution may be judged socially superior to an economically efficient solution, (2) the traditional solution does not consider the effect of private and social interests, (3) costs associated with overdrafting a ground-water reservoir are nonseparable, and (4) a traditional solution implicitly assumes control over all variables. A solution within a modern water context may entail one or more of the following schemes: (1) efficiency aspects: adjudication, (2) pump tax, and (3) equity aspects. (Grossman-Rutgers)
W69-00171

ECONOMICS OF WATER POLLUTION,
Dept. of Agriculture, Economics Research Service.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00172

WATER RESOURCE PLANNING IN NORTH CAROLINA.
North Carolina State Dept. of Water Resources, Raleigh.

North Carolina Dept. of Water Resources, Raleigh, N.C. July 1964, 214 pp, 11 illus, 15 tab, 41 ref, 1 append.

Descriptors: Political aspects, State governments, Water management, *Water supply, *Pollution abatement, Recreation, Flood damage.
Identifiers: North Carolina Department of Water Resources.

Included in this report is a comprehensive survey of water resources planning; an inventory of existing plans, a generalized projection of short, medium and long range program needs, and a preliminary blueprint of some planning guidelines for the future. Outlined in detail are the economic background and population trends, with a discussion of their impact on water resources for the future. A review of existing water resource programs in North Carolina in pollution abatement, water supply recreation, flood damage protection and the organization and administration of the programs is discussed, along with a detailed explanation of their functions. The financing by local, state and federal government is reviewed. After this specific discussion of North Carolina water resource planning, there is a general discussion of the role of planning in water resource development. Water resource planning and trends in other states are reviewed. In conclusion, recommendations for future water resource planning with organization for implementation are given. (Gargola-Chicago)
W69-00173

INTERGOVERNMENTAL RESPONSIBILITIES FOR WATER SUPPLY AND SEWAGE DISPOSAL IN METROPOLITAN AREAS.
Advisory Commission on Intergovernmental Relations.

Advisory Comm. on Int. Relations, Report No. A-13, Wash., D.C. Oct. 1962, 135 pp., 5 tab, 72 ref, 2 append.

Descriptors: Economies of scale, Water rates, Political aspects, Water quality control, State jurisdiction, Water allocation, Legislation.
Identifiers: Multipurpose vs. single purpose.

Discusses the problems of urban water quality and quantity, regional variations, and the difficulties of balancing and adjusting varying governmental interests. Local water problems of inadequate investment, failure of individual systems, and the fragmentation of this public function are examined in detail. Various metropolitan approaches are given; arguments for a comprehensive plan include the economics of scale, equalization of water and sewer rates, and fewer unwise investments. Considered then are the political realities in relation to these approaches; the difficulties of the multi-purpose approach are discussed in comparison with the easily implemented single-purpose plans. The state's role in urban water planning is reviewed in the areas of allocation, regulation, facilitation and development. Concerning governmental involvement, suggestions for the role of the federal government in quality and quantity control are given. It is decided that the problems of water resource management are more governmental than technical; ten suggestions for future developments, with plans to implement them are then given. In conclusion, models for acts - State Water Resources Planning and Coordination Act, and Control of Urban Water Supply and Sewerage Systems are suggested. (Gargola-Chicago)
W69-00174

ROANOKE VALLEY REGION WATER RESOURCES PLAN.
Howard, Needles, Tammen and Bergendorf.

Roanoke Valley Regional Planning Comm, Dec. 1967, 90 p, 38 plat, 90 tab, 24 ref.

Descriptors: Land-use, Water supply, Waste disposal, Urbanization, Economic resources, Non-structural alternatives, Financing.
Identifiers: Roanoke Valley, Va., Roanoke, Va.

This comprehensive regional plan provides the framework for solving the immediate and long range water and sewerage problems of the Roanoke Valley Region. The plan is based on certain relevant considerations of population, and its relation to topography, land use and zoning. Existing sources of water are reviewed, with the conclusion that existing facilities will no longer adequately serve the region by 1975. Possibilities of new sources are explored. Under the proposed plan, distribution of water would be accomplished by means of an inner and outer loop system which would center on the city of Roanoke. Construction of a dam, water treatment facilities, transmission pipe lines, and major distribution lines with sewerage treatment works form the bulk of the proposed plan. A Regional Water and Sewer Commission or similar organization is proposed which would administer, maintain and develop the facilities. A plan of bond financing is outlined for acquiring and constructing the system. (Gargola-Chicago)
W69-00175

WATER FOR ILLINOIS: A PLAN FOR ACTION.
Illinois State Gov't., The Technical Advisory Committee on Water Resources.

The Technical Advisory Committee on Water Resources, State of Ill., March 1967, 452 pp, approx. 170 fig, approx 150 photo, approx. 100 tab, 73 ref.

Descriptors: Water sources, Water supply, Pollution abatement, Recreation, Water law, River basin planning, Navigation.
Identifiers: Illinois, Bellwood, Ill., Bloomington-Normal, Ill., Carbondale, Ill., Chicago, Ill., Joliet, Ill., Decatur, Ill., Lombard, Ill., Peoria, Ill., Pekin, Ill., Moline, Ill., Urbana-Champaign, Ill., Madison County, Ill.

Contained in an overall, comprehensive discussion of Illinois water resources, economy, and population trends. A discussion of water supply and use with case studies in Illinois is given. Of the studies, most significant as an example of metropolitan development is the Chicago study. Here a history of

water supply and ownership is given and pollution problems and their present solutions are discussed. The advantages of the lake and problems of pollution abatement are reviewed and suggestions for a further improved water supply are given. Also discussed are the problems of urban occupance of agricultural levee districts. Plans for water based recreation in Illinois are outlined with suggestions for future developments and possibilities for funding from state, local, and federal sources. The ways and means through which the State and its subivisions, assisted by federal aids, meet their responsibilities in water resource management is defined. A review of organization and funding in other states is done. Navigation and river basin planning are discussed and suggestions for future developments proposed. (Gargola-Chicago)
W69-00176

WATER RESOURCES IN THE RFF PROGRAM,
Resources for the Future, Washington, D. C.
Allen W. Kneese.
In Resources for the Future, Washington, D. C., March 1964, 70 p.

Descriptors: Discount rate, Cost-benefit analysis, *River basin development, *Recreation, *Water supply, *Decision making, Water pollution, Flood damages, Political aspects.

Provided is a general background of programs and studies being carried on in pollution, river basin development, recreation, water quality, public interest in water resources and increased water supply. A general review of works published in these areas is also included. Outlines of areas needing study are suggested with plans for allocation of funds to them. A review of studies of particular benefit/costs associated with water resource development and use is given: (1) water quality aspects of recreation value-with studies under way or completed; (2) aspects of water quality in relation to salinity, treatment, and stream flow regulation; and (3) control of flood damages. Following is a discussion of system optimization and other general problems of decision making in the public interest. Some of the specific problems examined are: (1) geographical extent of the water resources planning and operating unit; (2) discounting for the future; and, (3) uncertainty of outcomes of public investment. Discussed are the ways political decisions and optimization analysis might be facilitated. General studies of policy issues and the role of the political process in water development is reviewed. Case studies underway in relation to the abovementioned areas are reviewed. (Gargola-Chicago)
W69-00178

METROPOLITAN PLANNING AND RIVER BASIN PLANNING: SOME INTERRELATIONSHIPS,
Water Resources Center, Georgia Institute of Technology, Atlanta.
Guy J. Kelnhofer, Jr.
Office of Water Resources Research, project B-009-GA, July 1968. 231 p, 13 fig, 6 tab, 229 ref.

Descriptors: *Metropolitan planning, *River basin planning, Metropolitan water management, Metropolitan areas, *River basin development, Metropolitan resources development, Georgia, Coordination, *Public development attitudes, Project planning, Decision making, Urbanization, Resource allocation, Public interest, Federal projects, City planning.
Identifiers: *Atlanta metropolitan area, *Chattahoochee River, Metropolitan planning agencies.

The relationships that exist between the planning of river basins and the planning of metropolitan areas in the management, use and development of water resources are examined. How, and the extent to which metropolitan area governments participate in decisions for water resources use and development in their regions is discussed. Attention is focused on the important aspects of the problem of planning for water resources management and use in metropolitan areas. Most metropolitan areas were found to be handicapped because no one metropolitan government is authorized to represent the metropolitan area and negotiate with river basin interests; and usually, there is no river basin management agency with whom metropolitan representatives could negotiate. Significant changes that could be made in local, State and Federal water planning procedures are suggested that, if implemented, metropolitan areas would have more and better control over the development and use of their water resources. Contains 229 references. (Water Resources Center-Ga Tech)
W69-00185

NORTHERN CALIFORNIA'S WATER INDUSTRY,
Resources for the Future.
Joe S. Bain, Richard E. Caves, and Julius Margolis.

In Johns Hopkins Press, Baltimore, Md., 1966, pp 1-17, 8 ref.

Descriptors: Water values, *Water supply, *Pricing, Water rates.
Identifiers: Northern California, *Theory of market, *Market models.

An 'industry study' takes as its frame of reference the structural taxonomy of market models, and is the approach used in dealing with the water supply and demand problem in this study of northern California. Presented is a regional water industry, examining from a clinical point of view its actual structure, conduct and performance. The aim of the study is ultimately that of deriving proposals for public policy affecting development of water resources. In the first stage, adapting the theory of markets, six distinctive features of the water industry are discussed. The second stage identifies important observable elements of the structure or environment of the industry that may have economic significance for explaining the character of its behavior and the quality of its performance. From this, further development of the industry study approach to water problems is outlined. (Gargola-Chicago)
W69-00186

POLICY HORIZONS FOR FUTURE URBAN WATER SUPPLY,
Resources for the Future.
J. W. Milliman.
Land Economics, Vol. 39, pp. 109-32, May 1963 21 pp, 2 fig, 1 tab, 26 ref.

Descriptors: Average price, Average costs, Discriminatory pricing, *Water rates, Unit costs, *Water supply, Marginal costs, Marginal benefits, *Peak loads.
Identifiers: Metering, Block rates, *Urban water economics.

Considering its importance, urban water economics does not hold a proper place in the field of water resource management. Three factors are responsible for this: the technology of municipal water supply has not greatly changed in 2000 years; economic costs of urban water supply have been very low in relation to worth; and the area has never been the subject of heated partisan debate. In the future this will change, and certain emerging policy issues will become more important. The role of technology, economics, and political decision-making are discussed, with reference to possible future trends. Problems of metering, price discrimination, block rates, and peak load are surveyed against a backdrop of rising water costs and the need to promote efficient water use. Suggestion for increasing the efficiency of urban water management is given, with a critique of established practices in setting level of water rates. (Gargola-Chicago)
W69-00187

TRI-COUNTY RIVERFRONT STUDY.
Tri-County Regional Planning Commission, Peoria, Tazewell, Woodford Counties, Ill.

Tri-County Regional Planning Commission, Peoria, Ill., Feb. 1968, 85 pp, 21 illus, 2 appen.

Descriptors: Geology, *Land use, Water quality, Watershed, *Future planning, *Water zoning.
Identifiers: Illinois River, Peoria, Woodford, Tazewell, *Riverfront planning.

Because a waterfront can be of great value in stimulating community development and facilitating industry it should be guarded against improper use. This study attempts to explore the Tri-County Illinois River development from two viewpoints; first, the Illinois River in terms of regional significance; secondly, the Tri-County riverfront area in relation to a more immediate geographic area. The physical characteristics and regional uses of the river are discussed. Background data, with implications for planning are outlined, and existing land use reviewed. Barge industry statistics are given with an outline of development in that industry. Guidelines for future development to preserve balance between private uses and public recreation and conservation needs are outlined. Shoreline and water surface conservation emerges as one of the most pressing needs. The present problems of the area reflect future needs, and recommendations are made from these. In conclusion a brief view of other successful waterfront projects is given. (Gargola-Chicago)
W69-00189

COMPETING USES FOR WATER AND OTHER IMPEDIMENTS TO IRRIGATION DEVELOPMENT,
North Dakota State Univ., North Dakota Water Resources Institute.
Thor A. Hertsgaard.
Great Plains Agricultural Council, Publication No 30, pp 23-28, Nov 1967, 6 p, 1 ref.

Descriptors: *Cost-benefit analysis, *Economic efficiency, *Productivity, Prices, Water utilization, Resource development, *Water rights.
Identifiers: *Economics, *Irrigation, *Water demand.

Water resource development projects are chosen on the basis of the benefit-cost ratio of the projects. Further, the outlay for the projects is warranted up to the point where marginal resource cost equals the marginal revenue product of the outlay. The problems of this method of project selection are discussed. If pure competition existed in a water resource market, then the market mechanism would allocate the water so that the marginal value product of water would be identical in all the uses of the water. Thus, the economic efficiency of water use would be maximized. The competition for water is not pure, so the market-price mechanism is not economically efficient. The alternative method of allocation is by use of water rights. This two has proven to be economically inefficient. Information needed to guide the choice of uses of water that will be consistent with maximum economic efficiency is given in the paper. (Grossman-Rutgers)
W69-00192

RIVER BASIN PLANNING AND URBAN DEVELOPMENT,
Georgia Inst. of Tech., Atlanta, Georgia, School of Architecture.
Guy J. Kelnhofer, Jr.
ASCE Journal of the Urban Planning and Development Division, Vol 93, No UP4, Proc Paper 5619, pp151-161, Dec. 1967 11 pp.

Descriptors: *Community development, Federal Government, Coordination.
Identifiers: *Planning, *River basin development.

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The coordination of river basin planning and metropolitan planning are important. Planning for river basin development should be brought under a unified command. The common objectives and plans of metropolitan areas must be based on a consensus. The increasing Federal emphasis on metropolitan planning and the creation of river basin planning agencies are two promising trends in the development of closer coordination in the planning of river basins and metropolitan areas. (Grossman-Rutgers)
W69-00194

IRRIGATION IN THE FUTURE,
Leeds, Hill and Jewett, Inc., Cons Engrs, San Francisco, California.
Harvey O. Banks.
ASCE Journal of Urban Planning and Development Division, Vol 93, No UP1, Proc Paper, pp 41-55, Jan 1967. 15 pp, 1 map, 5 tab, 10 ref.

Descriptors: *Projections, Federal Government, Federal Reclamation law, *Water policy, Resources.
Identifiers: Irrigation programs, *Future planning (Projected).

Projections of need for irrigated agriculture in the next 50 years were calculated for three areas. For California, irrigated acreage is projected to increase by one-third; in Texas, to more than double; and in the Erie-Niagara Basin, of western New York State, to increase nine times. For these projections it was assumed that water will be available at prices within irrigator's payment capabilities. Also, technological advances were postulated. Future irrigated agriculture probably will not be able to pay the full cost of supplying irrigation water. The continuing need for subsidy must be recognized and a uniform nation-wide policy should be adopted by the Federal Government. The price for irrigation water from Federal projects should be high enough to encourage efficient use. Acreage limitation provisions of Federal Reclamation law should be modernized to promote efficient agriculture. (Grossman-Rutgers)
W69-00195

FRAMEWORK FOR ANALYSIS OF IRRIGATION DEVELOPMENT,
Oklahoma State Univ., Stillwater, Department of Agricultural Economics.
Vernon R. Eidman.
Great Plains Agricultural Council, Publication No 30, pp 90-102, nov 1967. 13 p, 1 fig, 14 ref.

Descriptors: Water rights, *Farm management, *Linear programming, Water allocation (Policy), *Water resources.
Identifiers: Economics, *Irrigation.

The maximization of the long run social welfare of the community is the dominant goal in water resource use. The optimum allocation of the available water supply on a farm is when the marginal value product of the water applied is equal in all of its uses and greater than or equal to the marginal cost of obtaining the water. Farm management research should be part of the broader framework of macro level studies and decisions. One method of research is to select the geographic boundaries of the study area and analyze the resource problems within the chosen area. Such tools as linear programming and aggregation techniques may then be used. An alternative model would be a simulation model in which variables are estimated by probability distributions and then various decisions are evaluated. (Grossman-Rutgers)
W69-00196

SURFACE WATER RESOURCES PLANNING IN HUDSON BASIN,
Tippetts-Abbett-McCarthy-Straton, Consulting Engrs., New York, N. Y. and Div. of Water Resources, N. Y. State Conservation Dept., Albany, N. Y.
Gerald T. McCarthy, and Nicholas L. Barbarossa.
ASCE Journal of the Hydraulics Division, Vol 94, No 2, pp 375-389, March 1968. 15 p

Descriptors: Hydraulics, New York, Planning, River basin development, Water resources, Water supply, Hudson River, Reservoir sites.
Identifiers: Mohawk River Basin, Water Resources Commission of the State of New York.

A reconnaissance study was made by the consultants for the Water Resources Commission of the State of New York. The objective was to evaluate the quantity and general quality of the ground water and surface water resources within the Hudson-Mohawk River Basin and Long Island. The study assesses the present utilization, analyzes and projects the water needs within a 15,000 sq. mile area, with a present population of 13,000,000 persons, to the year 2020. The entire study area was screened for potential reservoir sites and suitable storage projects were located in the headwater regions. The techniques used to screen potential reservoir sites are described and are believed to have wide application to water resource planning for large river basins. Alternative solutions are developed for municipal water supplies for four regions: (1) Upper Hudson River Basin; (2) Mohawk River Basin; (3) Lower Hudson River Basin; and (4) New York City, West Chester County and Long Island. Special attention is given to water supply problems of New York City and vicinity. The plans presented show relative costs of a number of alternative solutions. (Seneca-Rutgers)
W69-00198

THE SOCIAL VALUE OF WATER RECREATIONAL FACILITIES RESULTING FROM AN IMPROVEMENT IN WATER QUALITY: THE DELAWARE ESTUARY,
Resources for the Future, Inc., Washington.
Paul Davidson, F. Gerard Adams, and Joseph Seneca.
In Water Research, Johns Hopkins Press, Baltimore, 1966, pp 175-211, 37 p, 4 fig, 4 tab, 22 ref.

Descriptors: *Delaware River, *Recreation facilities, *Water quality, *Cost-benefit analysis, Social values, Swimming, Fishing, Boating, Probability, Supply, Benefits, Costs.
Identifiers: *Water recreation, *Water recreational facilities, *Delaware Estuary, Social benefits, Social costs, Market failure.

After analyzing the causes for the failure of markets to provide for outdoor water recreational facilities, the authors performed a benefit-cost analysis of the recreational value of Delaware River water quality improvement. Data from a Public Health Service study was used to estimate a total cost of water quality improvement function. A survey conducted by the Michigan Survey Research Center provided the data for the estimation of empirical relationships between a sizable number of socioeconomic characteristics and the recreational use of water for boating, fishing, and swimming. Projecting the size and characteristics of the population, the demand and marginal benefit functions for water recreation were estimated through 1990. From these estimates an approximation of the optimal level of water quality improvement for recreation was estimated. (Seneca-Rutgers)
W69-00205

A CASE STUDY IN INCOME REDISTRIBUTION FROM RESERVOIR CONSTRUCTION,
Kentucky Univ., Lexington
James L. Douglas.
Water Resources Research, Vol 4, No 3, pp 499-506, June 1968. 8 p, 3 tab, 13 ref.

Descriptors: *Reservoir construction, *Flood control, *Economic efficiency, Cost-benefit analysis, Benefits, Costs, Recreation, Taxes, Water resources.
Identifiers: *Income redistribution, *Flood benefits, *Recreation benefits, Objective function, Dewey Reservoir, Weighting factor.

Because water resources investment has been evaluated from the economic efficiency objective, benefit-cost analysis has been criticized as ignoring other goals. Benefit and cost data collected for Dewey Reservoir in the Appalachian Mountains of Eastern Kentucky were used to determine the incidence of benefits and costs among income intervals. Recreation as a project purpose proved more effective in redistributing income than flood control. Weighting the income maximization and income redistribution objectives according to the value judgment that income taxes collected represent equimarginal sacrifice showed income redistribution benefits to equal 18.2% of efficiency benefits. The percentage would be lower in higher income areas. (Seneca-Rutgers)
W69-00208

BENEFIT-COST ANALYSIS: ITS RELEVANCE TO PUBLIC INVESTMENT DECISIONS,
Resources for the Future, Inc, Washington, D. C.
Arthur Maass.
Water Research, Johns Hopkins Press, Baltimore, 1966, pp 311-328, 18 p, 1 tab, 16 ref.

Descriptors: *Cost-benefit analysis, Welfare, Economic efficiency.
Identifiers: *Tradeoff ratio, Public investment, *Redistribution of income, Objective function, Legislative process.

An evaluation of the branch of welfare economics known as benefit-cost analysis is undertaken. The limitation of benefit-cost analysis is that it ranks projects and programs only in terms of economic efficiency. However, the objective of most public programs is not economic efficiency alone, but additional goals such as redistribution of income and the promotion of national self-sufficiency. Thus, benefit-cost analysis may be largely irrelevant. However, both objectives can be accomplished (efficiency and income redistribution for example) if a tradeoff ratio between efficiency and income redistribution is specified. There is a capacity in the legislative process to make tradeoff decisions. However, the field of public investment for which the present benefit-cost technique is most advanced, water resources, is the field for which political technique for determining tradeoffs between efficiency and other objectives is most primitive. Thus, one should combine benefit-cost analysis with an equally sophisticated technique relating efficiency benefits and costs to those stemming from other objectives. The need for changes in the theory of welfare economics is discussed and evidence is provided that tradeoffs can be determined. (Seneca-Rutgers)
W69-00211

FEASIBILITY OF WATER EXPORT,
Manitoba Univ, Winnipeg, Canada.
Edward Kuiper.
Proc Amer Soc Civil Eng, J Hyd Div, Vol 94, No HY4, 873-891, July 1968. 19 p, 5 fig, 1 tab, 6 ref.

Descriptors: *Water supply, Desalination, Irrigation, Pumping, Reservoirs, Rivers, *United States, Water resources, Treaties.
Identifiers: *Canada, *Water export, British Columbia.

This paper reviews the various aspects that are associated with exporting water from one country to another. The general criteria that must be satisfied before export can be contemplated are (1) the exporting country must have a surplus of water; (2) the importing country must have a deficit of water; (3) there must be a mutual advantage in the transfer of water; (4) the two countries must come to an agreement regarding a water export-import treaty. The author describes the application of these criteria to the Canada-United States situation. The continent is divided into three regions: mountain west, prairie, and east. In each region Canada's surplus water in the foreseeable future and the approximate cost of providing it to the United States are calculated. The possibility ap-

pears small that Canadian water export will become economically feasible in the near future. (Seneca-Rutgers)
W69-00213

ENVIRONMENTAL ASPECTS OF RIVER BASIN PLANNING,
North Carolina Univ, Chapel Hill.
Maynard M. Hufschmidt.
Proc Amer Soc Civil Eng J Hyd Div, Vol 93, No HY6, pp 323-333, November 1967. 11 p.

Descriptors: Benefit-cost analysis, *Planning, Environmental effects, Hydraulics, Rivers, Systems analysis, *Water resources, Administrative agencies.
Identifiers: *Environmental quality.

Current methods, substance, and administration of river basin planning in the United States must be changed substantially to accommodate the increasing national concern for problems of environmental quality. Modifications will be required in planning theory: improvement or environmental quality should be adopted as a major national objective, along with currently accepted objectives of economic efficiency and income distribution. Significant changes are also needed in methods of estimating benefits, cost and production functions, and in the planning process and techniques. Systems analysis methods must incorporate many environmental quality parameters, alternative development estimates and management measures. Planning for river basins and for metropolitan areas must be integrated. Important changes required in water resources policy, organization and administration are discussed. Extensive research and experimentation on new methods and approaches are required by research centers and public agencies concerned with water resources and environmental quality problems. (Seneca-Rutgers)
W69-00214

THE ECONOMIC VALUE OF REAL ESTATE ACQUIRED FOR RIGHT-OF-WAY,
Kentucky Univ., Lexington.
L. Douglas James.
Land Economics, Vol 44, No 3, pp 363-370, Aug 1968. 8 p, 1 fig.

Descriptors: *Right-of-way, *Land appraisal, Condemnation, *Cost-benefit analysis, Economic justification, Real property.

A method was developed for estimating the personal value (i. e., value to the owner in excess of what he can realize through market sale) of real estate acquired for water resources development based on statistical analysis of data collected from three reservoirs constructed by the U. S. Army Corps of Engineers. The personal value is the product of the relationship developed over time between the owner and his real property and community. Since this value is real to the owner in that it makes him an unwilling rather than a willing seller and since it is lost through forced sale, lost personal value is a legitimate economic cost and as such should be considered in the economic evaluation of public works projects. (Author)
W69-00216

RESEARCH AND DEVELOPMENT RESOURCE ALLOCATION UNDER RIVALRY,
Michigan Univ, Ann Arbor.
F. M. Scherer.
Quarterly Journal of Economics, Vol. 81, No 3, pp 359-394, August 1967. 36 p, 5 fig, 2 tab.

Descriptors: Research and development, Technology, Theoretical analysis, *Resource allocation, *Competition, Costs, Return, *Profit, Time, Welfare.
Identifiers: Duopoly, Market share, Quality, Innovation.

Taking into account the development schedules of rival firms and assuming a convex tradeoff between total development cost and development time, this article explores several models of inter-firm rivalry in the development of technically advanced new products. Major results include (1) Cournot-type rivalry leads to more rapid development of new products than either monopolized development or joint profit maximization. (2) The deeper the stream of quasi-rents at stake, the shorter are the minimax, joint profit-maximizing and Cournot equilibrium development schedules and the higher are total development costs. (3) In a broad class of cases, firms with relatively small market shares have stronger incentives to innovate rapidly than dominant firms. However, dominant firms accelerate their development efforts when their market positions are threatened by small innovators, and this action may induce a submissive reaction on the part of the smaller firms. (4) Firms are more apt to accelerate their development efforts in response to rival schedule accelerations when technological leadership can confer permanent market share changes.
W69-00218

BENEFIT-COST ANALYSIS AND THE NATIONAL OCEANOGRAPHIC PROGRAM,
Washington Univ, Seattle.
James A. Crutchfield, Robert W. Kates, and W. R. Derrick Sewell.
Also Clark Univ, Worcester, Mass; Victoria Univ, Canada. Natural Resources Journal, Vol 7, No 3, pp 361-375, July 1967. 15 p.

Descriptors: *Oceanography, *Planning, *Cost-benefit analysis, Recreation, Benefits, Fisheries, Weather forecasting, Prices, Allotments, Sewage disposal, United States.
Identifiers: National Academy of Sciences, Opportunity cost.

In 1964, a study by the National Academy of Sciences attempted to estimate benefits stemming from oceanographic research over a ten year period and to compare these estimates with the research cost to provide a basis for planning a national oceanographic program. Three basic conceptual weaknesses are evident in the NAS report: (1) in several places, such as in the valuation of outdoor recreation, benefits have either been calculated in gross terms or opportunity costs have been neglected; (2) the study ignores the impact of additional output on prices; (3) the study makes no attempt to define the appropriate composition of the oceanographic program marginal benefit-cost ratios for separable elements ranging from nearly unity to eight are indicative of a serious imbalance. Besides having conceptual weaknesses, the study has serious errors in its estimates of gross benefits. The authors conclude that while a more sophisticated and conceptually sound benefit-cost analysis of the national oceanographic program would be useful, there remain many areas in which the principal output of the program will continue to be scientific knowledge rather than economic benefits. A purely mechanical application of benefit-cost analysis would be inappropriate. (Seneca-Rutgers)
W69-00222

LAKESHORE PROPERTY VALUES: A GUIDE TO PUBLIC INVESTMENT IN RECREATION,
Wisconsin Univ, Madison.
Elizabeth L. David.
Water Resources Research, Vol 4, No 4, pp 697-707, August 1968. 11 p, 1 tab, 11 ref.

Descriptors: Recreation demand, Recreation, Water quality, Water pollution, *Property valued value, Access routes, Lake shores, Swamps, Topography, Population, Surface waters, Public lands, Water level fluctuations, Wisconsin.
Identifiers: Improvement value, Public investment.

A study of lakeshore property values in which land and improvement values were regressed against attributes of the site and the lake to determine the importance of the various characteristics in predicting property values indicates that swampy or steeply sloped banks are negatively correlated with value. Water quality, proximity to population centers, and the presence of many other lakes in the area are positively related to value. No significant relationships were discovered between land values and the amount of public land in the vicinity or the degree of fluctuation in the lake level. Property values approximately doubled in the ten year period of the study. By suggesting characteristics that seem to be in greater demand, the study provides information to guide some of the decisions about where to spend the limited public budget for waterfront recreational facilities. (Seneca-Rutgers)
W69-00227

EXCESS BENEFIT,
Virginia Univ, Charlottesville.
Gordon Tullock.
Water Resources Research, Vol 3, No 2, pp 643-644, Second Quarter 1967. 2 p.

Descriptors: Taxes, *Water pollution, *Effluents, Industrial wastes, Legal aspects.
Identifiers: *Externalities, *Excess burden, Excise taxes, Subsidies.

If some activity imposes an external cost, then a properly calculated tax on it will reduce the total output of the private sector by less than the revenue received by the government. If the external cost is large, it is possible that the government revenue will be 'free.' This means that the private sector will be as large, or larger, after the tax has been paid. This type of excise tax is clearly the most desirable of all taxes. In most water pollution cases the situation is not this clear but it is still true that gains can be made. A tax on the discharge of effluents by industry into a river produces an excess benefit instead of an excess burden. Indeed it seems likely that taxes on sources of water and air pollution would produce quite considerable revenues, while improving general well-being. Such a tax, if completely unaccompanied by subsidies to people who are injured, may not insure optimum utilization of our natural resources, but it will usually be better than raising the same revenues from taxes that carry substantial excess burdens. (Seneca-Rutgers)
W69-00228

ECONOMIC EVALUATION OF WATER-ORIENTED RECREATION IN THE PRELIMINARY TEXAS WATER PLAN,
Texas Agricultural Experiment Station and Texas Techonological College, and Texas Water Development Board.
Herbert W. Grubb, and James T. Goodwin.
Texas Water Development Board Rep 84, 28 p, Sept 1968. 4 fig, 3 tab, 7 ref 1 append.

Descriptors: *Cost-benefit analysis, *Recreation demand, *Reservoirs, *Texas, Statistical methods, Regression analysis, Least squares method, Multiple-purpose projects.
Identifiers: Reservoir recreation benefits.

Potential recreation benefits from reservoirs proposed for inclusion in the Texas Water Plan were estimated. Data collected during a 1965 survey of 8 reservoirs were used with population and income data to estimate a recreation visitation prediction equation. A least square regression was fitted to a double logarithmic transformation of the original data. Statistically significant explanatory variables are population, per capita income, cost of travel to reservoirs, proximity of competing reservoirs, and reservoir size. Correlation coefficients, estimated number of visits (1970-2020), and estimated recreational benefits of proposed reservoirs (1970-2020) are tabulated. (Knapp-USGS)
W69-00261

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APPROACHES TO WATER RESOURCE DEVELOPMENT IN CENTRAL AND SOUTHERN FLORIDA, 1845-1947,
Florida Univ, Gainesville, Public Administration Clearing Service.
John M. DeGrove.
Studies in Public Administration No. 17, pp 1-53, 1958. 13 p, 1 map, 20 ref.

Descriptors: Drainage programs, Irrigation programs, Hydroelectric plants, Municipal water, Industrial water, Land reclamation, *Water resource development, Multiple-purpose projects, Tennessee Valley Authority Project, Coordination, *Local governments, Long-term planning, Optimum development plans, *Federal government, Project planning.

Acute problems in administration, finance, and inter-governmental cooperation present themselves in an interwoven pattern that defies separate analysis. One of the most complicated and vexing illustrations of policy-administration confusion lies in the area of the economic evaluation of water resource projects. The whole question of the economic evaluation of water resource projects has become a sort of political football in which agencies go through an elaborate mathematical exercise to support the pre-conceived fact that they are best suited to develop the project in question. The necessity of developing any major water project within the framework of a federal system further complicates the inadequacies of federal-state-local organization for dealing with the problem. An almost insuperable handicap in attempts to develop effective cooperative patterns which will allow full utilization of the nation's water resources grows out of the administrative dispersion problem at the local, state, and federal level. The pattern since the 1930's may be characterized as one in which a more or less uncoordinated cooperation between federal and state-local agencies. (R. Smith-Fla)
W69-00269

ECONOMIC AND RELATED PROBLEMS IN CONTEMPORARY WATER RESOURCES MANAGEMENT,
New Mexico Univ., Albuquerque School of Law.
Allen V. Kneese.
Nat Res J, Vol 5, No 2, pp 236-258, Oct 1965. 22 p, 31 ref.

Descriptors: *Water resources development, *Administration, *Water utilization, *Competing uses, Water allocation (Policy), Water policy, Water conservation, Watershed management, Planning, Water quality, Water requirements, Water supply, Recreation, Water values, Water users.

Problems of allocating existing water supplies among competing demands are taking the place of the problem of developing unused supplies. Economic theory has provided a model of efficient resource allocation for planners. Problems of reallocation of water or water transfers and their ramifications, such as effects on third parties, are discussed. There is a growing problem of estimating the value to be placed upon the use of water for recreational purposes. Water quality appears to be the major national water resource problem in the coming decades. Much additional research is necessary in the area of industries affected by, and causing, water pollution. Additional research into control of flood damage is necessary. Inland navigation, its development and use by such activities as large transportation, should be critically analyzed and compared with alternatives such as pipelines. Research toward achieving optimum efficiency from a system is necessary. The comparative evaluation of present and future benefits and costs from public investments such as water resources management systems is discussed. More appropriate methods of handling the risk and uncertainty associated with water resources projects must be developed.
W69-00288

SOME IMPORTANT RESEARCH PROBLEMS IN THE WATER RESOURCES FIELD,
New Mexico Univ., Albuquerque School of Law.
Blair T. Bower.
Nat Res J, Vol 5, No 2, pp 286-297, Oct 1965. 11 p, 10 ref.

Descriptors: *Project planning, Project purposes, Competing uses, *Cost-benefit analysis, Multiple-purpose projects, Administration, Benefits, *Operations research, Water resources development, Project benefits, Analytical techniques.

The article deals with pressing problems of research which will pay off in terms of improved water resources planning and management. The problems of coping with uncertainty stemming from shifting and increasing demands for water and from unpredictable water supplies are discussed. Estimation of hydrologic uncertainty is not the only problem. Flexible water resource systems, analysis of alternative demand patterns over time, changing the end product-time focus of water resources planning, and a system of continuous planning are suggested as procedures for coping with other uncertainties. Study of the relative accuracy of data relating to various types of water resources systems is necessary. Integration is necessary between all authorities dealing with water resources. The problems of planning and developing operating procedures for water resources systems and the evaluation thereof are discussed. Research into the benefits to be derived from various water quality improvements and their value is necessary. Problems such as the relationship between water resources systems and spacial development municipalities, and the benefits from area-wide facilities are discussed.
W69-00289

ORGANIZATIONAL ARRANGEMENTS FOR WATER DEVELOPMENT,
New Mexico Univ., Albuquerque School of Law.
Irving Fox, and Lyle E. Craine.
Natural Resources J, Vol 2, No 1, pp 1-44, April 1962. 45 p, 34 ref.

Descriptors: *Administration, Administrative agencies, Administrative decisions, *Institutions, *Water resources development, Water policy, Water law, *Organizations, Long-term planning, Multiple-purpose projects, Planning, Non-structural alternatives, Optimum development plans, Regional analysis, Political aspects, Social aspects, Physical properties.
Identifiers: *Analytical structure, *Environmental factors.

This paper takes issue with the assumption of many proposals for organizational improvements in water resources activity that the problem is basically one of overlapping functions and bureaucratic ambitions. The purpose of this paper is to suggest an analytical structure that permits consideration of the problem in terms of fundamental environmental factors. The first part attempts to identify, classify and appraise environmental factors which affect the design of institutional arrangements for water development. This part provides an analytical structure composed of four categories of factors: (1) the value system and its requirements for decision making; (2) the characteristics of the function of producing water services; (3) the significance of relationships among the processes of water development; and (4) the general institutional environment. Part Two explores implications of applying this analytical structure to existing problems of water resources organization. In conclusion, it is hypothesized that there are two interrelated parts in the problems of the analytical structure: (1) finding ways of providing organizational arrangements that are capable of maximizing welfare; and (2) finding ways of motivating water development organizations to maximize welfare. Solutions are offered for both parts of the problem.
W69-00296

WATER AND LIFE,
Lorus Milne, and Margery Milne.
Published by Atheneum, New York, pp 1-257, 1967. 275 p, 54 ref.

Descriptors: *Water utilization, *Water conservation, *Water resources development, *Water users, Bodies of water, Hydrologic cycle, Rain, Water storage, Environmental sanitation, Water pollution, Cloud seeding, Dew, Forests, Wetlands, Saline water, Desalination, Animals, Sewage, Industrial wastes, Pesticides.

Chapter 1 describes water as a part of the human body, approximately three-tenths of body weight. Chapter 2 encompasses the world's water ways. Navigation, irrigation, consumption by humans, recreation, and flooding are mentioned. Chapter 3 is devoted to the hydrologic cycle. Emphasis is on precipitation and human consumption statistics, as well as water storage, water pollution and sanitation. A revamping of the sewerage system is called for. Pollution is also the topic of Chapter 5 with emphasis on insecticides and industrial wastes. Chapter 6 covers rain, clouds, and cloud seeding. Chapter 7 examines the characteristics and uses of dew. Chapter 8 covers forests. Wetlands are examined in Chapter 9, i.e., an area where water stands for part of the year but in excess of ten feet deep. Chapter 10 discusses salt water and man's ability to cope with saline water problems. Chapter 11 deals with the ability to survive without water with emphasis on the camel. Chapter 12 covers sea exploration and research including desalination. The remaining three chapters examine various characteristics of water, such as its use in dehydrated foods, beautification by statute, and irrigation projects. (Breuel-Fla.)
W69-00307

MANAGEMENT OF WATER RESOURCES FOR REGIONAL DEVELOPMENT,
Dept. of Agriculture, Economic Research Service.
Harry A. Steele, and William A. Green.
Iowa State University Center for Agricultural and Economic Development, 1966 p 145-65, 9 fig, 22 ref.

Descriptors: Market value, Gross national product, Water use, Precipitation, Water requirement, Water consumption, *River basin development, Water resources development, Project planning, Water supply, *Future planning, Optimum development plans, Interagency cooperation, *Federal project policy, Irrigation programs, Long term planning, Short term planning.
Identifiers: Economic base studies, Development need functions.

Explored is the relation of water resources to economic activities, and the application of economic base studies in the formulation of river basin programs. There exists a complicated interrelationship between land and water, which to a large degree affects the growth of the economy. In an attempt to study this a general review is made of the use of the nation's water supply and regional water resources and requirements. It is suggested that investigations be conducted to ascertain pertinent physical and economic information, and that this data be used to form technical and factual guidelines for national water policy. Two major types of investigational efforts are being carried out. The first includes regional studies of water resource problems, while the second deals with selected sub-basin areas. Development-need functions of water resource development are shown with a general outline of necessary elements for the study of drought and irrigation. Potential for water resource development is reviewed and in conclusion a summary of problems and issues is given. (Gargola-Chicago)
W69-00390

PUBLICATIONS IN OPERATIONS RESEARCH NO. 3: (ESTABLISHING CRITERIA FOR WATER RESOURCES PROJECTS),
Rand Corporation Research Study, Santa Monica, Calif.
Roland McKean.
Operations Research Society of America, John Wiley and Sons, Inc., 1968, p 103-127, 7 tab, 7 ref.

Descriptors: *Cost-benefit ratio, Discount rate, *Annual benefits, *Annual costs, Assessments, Capital, Capital supply, Cost-benefit analysis, Market value, Intangible benefits, Intangible costs, Net profit, Operating costs.
Identifiers: Net worth, Time streams, Ratio of present values, *Internal rate of return.

Argued is the validity of examining benefit-cost estimates for government projects with a discussion of difficulties in applying benefit-cost analysis to given projects. The limitations of ratios of annual benefits to annual costs is reviewed. It is concluded that the significant factor is profit on investments or prospective change in present worth; in measuring only gross benefits to costs, certain projects will not be properly assessed. In fact, benefit-cost ratios may be an inherently incorrect criterion for water resource projects. Possible discount rates, another problem of applying benefit-cost analysis, with special time preferences are reviewed. A method for ranking alternatives is outlined, considering that interdependent projects cannot be separately ranked. Although no single test can point clearly to the set of projects that is optimal, guidelines can be indicated and sources of error avoided. (Gargola-Chicago)
W69-00392

DEVELOPING AND MANAGING THE WATER RESOURCES OF N.Y. STATE.
New York State Water Resources Comm., Divison of Water Resources.

N.Y. State Water Resources Comm, Div. of Water Res, Albany, N.Y., 1967, 53 p, 14 fig, 24 photo, 3 tab, 1 chart.

Descriptors: *Water resources development, Interstate commissions, Long-term planning, *Multiple-purpose projects, Municipal water, Water demand, Water management, Recreation demands, Water quality control, Water supply, Navigation, Flood control, *Resource allocation, *Optimum development plans, Flood control, *Reservoir sites, *Reservoir operations, Climatic data.
Identifiers: New York, N.Y. State Water Res. Comm., Susquehanna River Basin, Oswego River Basin.

A review of problems in recreation, lake management, water quality, water supply, flood control, and other areas is given in brief summary for the entire state. To aid in the solution of these problems a general plan is put forth, with the primary objective of providing a framework within which the optimum allocation of water resources can be found. Suggestions for implementing the plan, through coordination of public and private interests are presented. Possible sources of financing on the state and local levels are discussed. The first step of the plan is the reservation of reservoir sites which is the substance of the program. Suggestions for additional action in development and management, which could follow, are given. The state is divided into three regions and the physical characteristics, economic aspects, climate, water supply, and water demand problems of each area outlined. Suggestions for reservoir sites are given with pertinent data for the most promising sites. (Gargola-Chicago)
W69-00393

A BENEFIT-COST ANALYSIS OF LOCAL WATER SUPPLY,
Louisiana State Univ, Baton Rouge, Economics Dept.
W. J. Stober, and L. H. Falk.
Land Economics, Vol. 39, No. 4, pp 328-335, Nov. 1963, 7 p, 1 fig, 1 tab, 5 ref.

Descriptors: *Benefit-cost analysis, Benefit-cost ratio, Economies of scale, Capital costs, Interest rate, *Cost comparisons, Average costs, Tax rate, Diseconomies of scale, Annual benefits, Interest rate, Water development, Municipal water, Water management.
Identifiers: *Public investment.

The problem of a community faced with a shortage of water for industrial and municipal use is examined. Two courses of action; a private project financed by industry, and a community project, publically financed, are considered within the framework of a benefit-cost analysis. The cost measurement of each is put forth, and in the comparison the community project emerges as the most economical. This conclusion is a direct result of the corporate income tax structure. A lower cost of capital to the community than to corporate water users has the effect of increasing the benefit-cost ratio. Although a community project is beneficial to the community, it can violate efficiency conditions for the National economy. (Gargola-Chicago)
W69-00395

THE DETERMINATION OF RESEARCH NEEDS IN WATER RESOURCE ECONOMICS,
Tennessee Univ., Knoxville, Ctr. for Business and Economic Research.
Charles B. Garrison.
OWRR Project No. A-009-TENN, Tennessee, Water Resources Research Center, 1968. 63 p.

Descriptors: Economic research needs, Income redistribution, Regional development, Recreation, Administration.

The project involves a systematic evaluation of water resource economic research needs in Tennessee. The five topics to be considered are: (1) Income Redistribution Effects of Water Resource Programs, (2) Benefits of Metropolitan Waterfront Renewal, (3) Regional Development Benefits of Water-Based Recreation Activities Induced by Reservoir Construction, (4) The Effect of Water Resource Investment Programs on Regional Economic Growth, and (5) The Administration of Water Distribution. Each topic will be evaluated as to specific objectives, scope, methodology and research plan. (Author)
W69-00396

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COMPUTERIZED LOCATION MODELS FOR ASSESSING THE IMPACT OF WATER RESOURCE PROJECTS,
Washington Univ., St. Louis, Missouri. Institute for Urban and Regional Studies.
Edgar M. Hoover.
In Impact of Water Resources Development on Economic Growth, Working Paper CWR 1, 55 pp, 2 fig, 35 tab.

Descriptors: *Computer models, *Computer programs, Resource allocation, Cost comparisons, Economic efficiency, *Economic evaluation, Economic feasibility, Unit costs, Operating costs.
Identifiers: *Location models.

One of the necessary operations in the overall cost-benefit appraisal procedure is to determine how the national location pattern of an industry would be affected by specified reductions in costs of materials extraction, cost of processing, costs of transportation, or material requirements per unit of product. Water resource projects could affect any of these factors. The programs contained in the report are designed to evaluate and measure possible effects. Program I determines the optimum pattern of outputs, shipments and sales for the industry and measures its efficiency in terms of total output and average delivered price. Geographical position, costs of producing the material at each source, cost of processing the material at each production location, amount of material required per unit product, parameters of transport cost functions, parameters of demand at various markets are inputs of the program. The procedure followed by the program and impact evaluations are then discussed. Six programs which follow are supplemental variants on the basic program and evaluate the impact of certain single variables. (Gargola-Chicago)
W69-00181

NORTHERN CALIFORNIA'S WATER INDUSTRY,
Resources for the Future.
Joe S. Bain, Richard E. Caves, and Julius Margolis.

In Resources for the Future, Johns Hopkins Press, Baltimore, Md. 1966, pp 347-363, 1 tab, 15 ref.

Descriptors: Water demand, Pricing, *Water rates, *Economic justification, *Marginal costs, Discriminatory pricing, Operating costs, Unit costs.
Identifiers: San Francisco Bay Area, Northern California.

Price differentials are employed in the sale of municipal water supplies outside the city. Various reasons are given for this, but none seem totally justified; the pricing structures seem to rest upon faulty analysis. Components of an urban water pricing schedule should include: (1) a fixed charge per period of time, and (2) a quantity charge which covers only incremental operating costs. Unfortunately these principles, and others discussed, are not followed by most municipal pricing systems. Demand and quantity prices which are charged, and arguments for these practices are reviewed. Discrimination through special rates, practiced by many municipal districts, is shown to promote a distortion of water allocation among classes of urban consumers, resulting in prices too low to reflect the long run marginal costs of the typical system. (Gargola-Chicago)
W69-00190

ON THE MARGINAL COST PRICING OF MUNICIPAL WATER,
New Mexico Univ., Albuquerque.
Gilbert W. Bonem.
Water Resources Research, Vol 4, No 1, pp 191-193, February 1968. 3 p, 1 fig, 4 ref.

Descriptors: *Marginal costs, *Pricing, *Municipal water, Water supply, Average costs.
Identifiers: *Spillover effects, Social benefits, Social optimum, Net benefits, Third party benefits.

It has been maintained that municipal water supply should be priced so that marginal cost equals price. However, there are likely to be 'third party' benefits from some components of municipal water use, primarily from the use of water for landscaping and gardening. Because gardening affects the quality of the urban environment, social benefits may exceed private benefits, and marginal cost pricing may result in a price that exceeds a socially optimal price. The magnitude of divergence of the marginal cost price from the optimal price will depend primarily upon the size of the 'third party' benefits. (Seneca-Rutgers)
W69-00203

DISCOUNTING AND PUBLIC INVESTMENT CRITERIA,
Resources for the Future, Inc., Washington.
Kenneth J. Arrow.
In Water Research, Johns Hopkins Press, Baltimore, 1966, pp 13-32, 20 p, 37 ref.

Descriptors: *Discount rate, *Interest rate, *Risks, Capital, Investment, Benefits, Costs, Optimization, Taxes, Financing.

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Identifiers: *Public investment, *Economic growth, *Imperfect capital markets, Public capital, Private capital, Utility.

The investigation deals with the problem of appropriate discount factors to be applied to the expected streams of benefits and costs generated by public investments. Theoretical problems related to general interest rate questions are discussed. Among them are the problems of imperfect capital markets, the interest rates implied by the growth of per capita consumption and the natural growth rate, the interest rate implications of public investment financing through taxation and borrowing, and the relationship of risk and uncertainty to the level of the appropriate interest rate. Among other things, the paper concludes that public investment policy should be based on a 'myopic rule' (that the present value must be positive), that optimal public investment policy with imperfect capital markets implies two rates of interest (one for private capital and one for public), and that the public sector should not make allowances for risk in choosing among investment alternatives. (Seneca-Rutgers)
W69-00204

THE CALIFORNIA WATER PROJECT: IS PUBLIC DECISION MAKING BECOMING MORE EFFICIENT,
Washington Univ., Seattle, Washington.
Gardner Brown, Jr.
Water Resources Research, Vol 4, No 3, pp 463-470, June 1968. 8 p, 27 ref.

Descriptors: *California, *Discount rate, Efficiencies, Water supply, Risks, Benefits, Elasticity of demand, Desalination, Prices.
Identifiers: *Water project, *Opportunity costs, Investment alternatives, California Water Project, Alternative sources.

It is argued that the use of an incorrect discount rate, the application of procedures that overestimate net benefits, and the failure to charge a scarcity price for water are inappropriate arguments against the value of the California State Water Project. However, the existence of alternative public investment opportunities and technological progress in desalination are two factors to which the State may have given inadequate attention. As a consequence, although the State's water pricing policy encourages more efficient resource allocation than that of the federal government, there are plausible grounds for believing that further improvement is possible. (Seneca-Rutgers)
W69-00206

OPERATIONS RESEARCH APPLIED TO ENGINEERING PLANNING,
Tennessee Technological University, Cookeville.
Albert A. Cannella.
Water and Sewage Works, Vol 115, No 7, pp 310-314, July 1968. 5 p, 7 fig, 9 ref, 1 append.

Descriptors: *Linear programming, *Operations research, *Project planning, Interest rate, Growth rates, *Water distribution (Applied), Water districts, Economic efficiency, Optimum development plans, Digital computers, Costs, Pumping, Design.

Some techniques of Operations Research were applied to a hypothetical water distribution cost minimization problem. Two phases of the problem were treated individually. The Phase I problem was to determine the main trunk line sizes between demand centers in a water district in order to minimize pumping costs. Center to center unit pumping costs were given. A linear programming method was used to find the optimal line routing. The Phase II a non-linear mathematical model was structured and used to find the optimum design periods based on projected demand growths that minimized expansion outlays. The capital outlay, a function of amortization and maintenance cost factors, interest rate, population growth rate, and planning period, was differentiated with respect to the planning period. An iterative process performed on a digital computer was used to solve the resulting equations to find the optimal design period. (Gysi-Cornell)
W69-00351

SENSITIVITY ANALYSIS OF ACTIVATED SLUDGE ECONOMICS,
Stanford Univ, Stanford, Calif.
Bernard C. McBeath, and Rolf Eliassen.
Amer Soc Civil Eng Proc, Vol 92, No. SA 2, pp 147-167, Apr 1966. 21 p, 5 fig, 4 tab, 8 ref.

Descriptors: *Activated sludge, *Economics, Analytical techniques, Biochemical oxygen demand, *Design criteria, Digital computers, Oxygen requirements, Biodegradation, Economies of scale, *Evaluation, Mathematical studies, Optimization, *Waste treatment, Economic efficiency, Sludge treatment, Sanitary engineering.
Identifiers: *Sensitivity analysis.

The sensitivity of cost of an activated sludge treatment system to some of the parameters used in its design was tested. The activated sludge process was described in terms of the effects of waste character treatment rates and construction and operational costs. The sensitivity analysis was performed on a computer using first a substitution of values method and then a pair by pair graphic display of cost response to parameter changes for parameters identified as critical. It was concluded that the procedure offered a means of parametric study for the purpose of describing some optimal characteristics of the system, as well as some means of identifying those characteristics. However, it was stated that the procedure gave optimal solutions only when the appropriate parameters were examined within the proper limits. (Gysi-Cornell)
W69-00352

6D. Water Demand

LUESSE V WEBER (USE OF LAKE SURFACE).

350 S W 2d 424-432 (Mo 1961).

Descriptors: *Non-navigable water, *Navigable water, *Lakes, *Barriers, Ownership of beds, Easement, Water utilization, Fishing, Riparian rights, Riparian lands, Water law, Legal aspects.

The plaintiff and the defendant are each owners of laud under and abutting a lake near the Mississippi River. The defendants have a pontoon bridge across the lake on their land. The plaintiff brought suit to have the bridge removed as an obstruction to navigation. The court avoided the question of whether an owner of land covered by a lake artificially raised was entitled to the use of the entire surface of the lake. They held that the lake was not a navigable body of water and that the lake had been divided into portions for the defendant and the plaintiff for 50 years thereby amounting to an acquiescence on the part of the plaintiff. Such acquiescence bars the plaintiff from asserting any right to injunctive relief. (Horner-Fla)
W69-00021

HYDROGEOLOGY AT SHELBYVILLE, ILLINOIS - A BASIS FOR WATER RESOURCE PLANNING,
Illinois State Geological Survey.
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00179

THE LAKE SUPERIOR WATERSHED UNIT.
Minnesota State Department of Conservation.

Minnesota Conservation Department Bulletin 24, February 1966, 61 pp, 9 fig, 2 map, 12 tab, 31 ref.

Descriptors: *Small watersheds, Geology, Topography, Surface water, Ground-water, Water quality, Water pollution.
Identifiers: Lake Superior, Nemadji river, Lake County, Minn., Cook County, Minn., St. Louis County, Minn., St. Lawrence Seaway.

Described are the water resources and water problems of the Lake Superior watershed unit. This unit is an elongated area which extends for 160 miles along the north shore of Lake Superior. A history of the area, with a review of climate, geology and topography, is given. The economic importance of the mineral resources, soils and forests of the unit are discussed. Reviewed then are the added advantages brought by the St. Lawrence Seaway to the Duluth-Superior harbor, and the potential for future development. General streamflow characteristics are defined and compared; low flow and floods are also discussed. The quality of both ground and surface water is measured, and the problem of water pollution discussed. Individual sewage systems contribute to ground water pollution, but by far, industrial wastes comprise the major source of pollution. In conclusion, the advantages and problems of the watershed unit are summarized. (Gargola-Chicago)
W69-00180

SUMMARY OF PRESENT PRACTICES IN EVALUATION OF WATER RESOURCE PROJECTS,
Washington Univ., St. Louis, Missouri. Institute for Urban and Regional Studies.
Raymond J. Struyk.
In Impact of Water Resources Development on Economic Growth, Working Paper CWR 13, 40 pp, 14 ref.

Descriptors: Project planning, *Cost-benefit analysis, Discount rate, Pollution abatement, Net profit, Alternative costs, Direct benefits, Indirect benefits, *Cost analysis, *Methodology, *Economic evaluation.

A statement of methods used in estimating future water demands of population, industry, and agriculture with an outline of water quality control and pollution abatement measures is given. The criteria by which flood control needs and recreation resources are examined is reviewed. Project formulation is carried out on the basis of an examination of the above factors, and preliminary study and elimination of alternatives is then done. Net worth and alternative worth of each project is compared. Further elimination of alternatives is then carried out. Primary benefits of each project, in water quality and supply, recreation, and fish and wildlife, are evaluated. Various approaches to the calculation of these benefits are examined. The evaluation of secondary benefits is then discussed in conjunction with this. General measurement procedures in cost analysis and the derivation of economic costs are discussed. Methods of progressive refinement and narrowing of the field of choice; screening of alternatives, order of merit approach, sub-basin approach, and functional approach, are given in brief summary. (Gargola-Chicago)
W69-00182

NORTHERN CALIFORNIA'S WATER INDUSTRY,
Resources for the Future.
Joe S. Bain, Richard E. Caves, and Julius Margolis.

In Resources for the Future, Johns Hopkins Press, Baltimore, Md., pp 179-191, 1966.

Descriptors: *Water demand, *Elasticity of demand, Pricing, Water rates.
Identifiers: Northern California, San Francisco Bay area.

Domestic or residential, public, commercial, and industrial use form the major components of urban water use. The determinants of urban demand are those factors which affect the above uses; included are climate, precipitation, income per capita, price per unit and other environmental conditions. Each

component of urban water use is affected by these factors to a greater or lesser degree. It is difficult to gain statistical evidence to assess the relative importance of these factors for many reasons. Cities do not state separately quantities of water demanded by different users. It is difficult to reveal the response of components of urban demand to change or difference in price of water, which is necessary for learning the elasticity of demand for water. Elasticity of demand plays an important part in any economic study and can hold considerable significance for both the performance and conduct of the water industry. From this a discussion or pricing, water rates, and interrelationships of the above factors is given. Low, but significant, elasticities of demand for water are supported, a conclusion which has importance in considering the pricing systems used by urban agencies which supply water. (Gargola-Chicago)
W69-00188

WATER FOR OREGON,
U. S. Geological Survey.
K. N. Phillips, R. C. Newcomb, and H. A. Swenson, et al.
Geological Water-Supply Paper 1649, 1965, 150 pp, 47 fig, 35 ref.

Descriptors: Topography, Water table, Water quality control, Flooding, *Water supply, *Water management, *River basin development, Water allocation.
Identifiers: *Oregon river basins.

The rate of flow, quality of water, topography and groundwater resources of Oregon's river basins are discussed. The severest and most common water problems result from the annual cycle of precipitation and runoff, causing dry streams in the warmer months and occasions of flash flooding in the rainy season. Protection against floods should lie in the proper location of towns rather than protective construction while in the dry season pumping of water from distant sources may be necessary. Problems of water purity and pollution are then discussed with suggestions for future development. Although demand is expected to increase as population grows, Oregon should have enough water to supply these demands. It is possible to double or triple the present water supply, and other sources might be developed if necessary. In conclusion, resources to meet future needs are discussed and four basic principles of water resource management put forth. (Gargola-Chicago)
W69-00191

THE WATER ECONOMY AND ITS ORGANIZATION,
New Mexico Univ., Albuquerque School of Law.
Vincent Ostrom.
Natural Resources J, Vol 2, No 1, pp 55-73, April 1962. 19 p, 2 ref.

Descriptors: *Water Allocation (Policy), *Competing uses, Administrative agencies, Non-consumptive use, Consumptive use, *Water resources development, *Planning, *Multiple-purpose projects, River basin development, Water utilization, *Area redevelopment, Interstate, *Tennessee Valley Authority Project, *Columbia River Basin, Hydroelectric plants, Utilities.

Goods and services that are derived from a water supply system can be allocated both by the private market and by the public economy. For a good to be amenable to allocation in the market, it must be 'packageable,' meaning it can readily be purchased or sold in the market economy. Those not willing to pay for the packageable good can be excluded from enjoying its benefits. Most consumptive uses or goods qualify for the exclusion principle. But most in-the-channel or consumptive uses do not qualify for the exclusion principle. The interdependency and competition among water uses militates for a multi-purpose approach. Experience with the Tennessee Valley Authority and in the Columbia Basin has shown that a single integrated agency cannot develop comprehensively the resources of a water supply system. A rich and complex system of organization, including a variety of both public and private agencies is needed to gain intelligence, recognize the interdependency among uses, and to mediate the conflicts between competing developers and users.
W69-00297

RHODE ISLAND WATER PLANNING,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00332

STATUS OF WATER RESEARCH IN THE UNITED STATES,
Roland R. Renne.
J Am Water Works Ass'n, Vol 60, No 7, pp 749-754, July 1968, 6 p.

Descriptors: Research development, Water resources development, Technology, Grants, Economics, Government finance, Long-term planning, Budgeting, Economic justifications, Federal government, Government finance, Legislation, Standards, Future planning.

There are six types of water problems in the U S: pollution, inadequate supply, uneven distribution, floods, variability of supply and demand, and water treatment. To meet the problems new legislation has launched a 3-way attack of research, planning and development, and quality control. However, too often the tendency is to short change basic research for the future and limit the research funds only to present problems. Federal expenditures for water research have doubled in the past 3 years however this is only 2.5% of federal expenditures for research. The Fed. Council for Science and Technology recommends that research funds be near the $200,000,000 by 1971. This requires an increase of 20% per year in order to achieve this goal. There are now 38 federal agencies involved in some aspect of water resource activities. One of the key agencies for water research is the Water Resources Scientific Information Center now operating from the Office of Water Resources Research. In looking to the future there are at least eight possible approaches to solving water problems: (1) water treatment, (2) reuse, (3) restricted or curtailed use, (4) use classifications, (5) improved management of watersheds, (6) desalting, (7) weather modification, (8) importation from other areas. (Kirk-Fla)
W69-00333

EFFECTS OF COMPETITION ON EFFICIENCY OF WATER USE,
Utah State Univ., Dept. of Civil Engineering, Logan.
Jay M. Bagley.
J Irri and Drainage Div (ASCE), Vol 91, No IR 1, pp 69-77, March 1965. 9 p.

Descriptors: *Water utilization, Arid climates, *Legal aspects, *Competing uses, Water demand, Institutional constraints, Irrigation efficiency, Administration, *Water allocation (Policy), Hydrologic aspects, Interstate compacts, Economic efficiency, Evaporation control.
Identifiers: Terminology, Flow systems.

Many factors operate to influence the relation between competition for water and its efficiency of use. Careful attention has to be given to definition of boundaries and terminology if meaningful relations were to be obtained in specific instances. An appreciation for the inter-connection of all natural waters together with their variable and mobile characteristics was needed. Recognition of the effect of legal and institutional mechanisms which modify the relation between competition and water use was required also. Specific examples illustrating both favorable and adverse effects of competition on efficiency of water use were given. The efficiency with which water is used in arid regions is particularly important. (Affleck-Ariz)
W69-00380

THE RELATION OF FAMILY INCOME AND USE OF WATER FOR RESIDENTIAL AND COMMERCIAL PURPOSES IN THE SAN FRANCISCO-OAKLAND METROPOLITAN AREA,
California Univ, Los Angeles, Water Resources Center.
Charles J. Headley.
Land Economics, Vol. 39, No. 4, p 441-49, Nov. 1963, 8 p, 5 tab, 4 ref.

Descriptors: Time series, Income analysis, *Elasticity of demand, Water rates, *Water demand, *Municipal water, Water supply, Policy matters, Unit costs, Project planning.
Identifiers: San Francisco-Oakland Metropolitan Area, *Income elasticity, Cross sectional model, Projections.

Defining the determinants of demand for water by urban users is done in a framework which focuses on the relation of family income to demand, holding other variables constant. A time series model and cross-sectional model are used to describe the unique and common features of each of the 12 cities studies. Data on water use, water purchases, and relation to income was gathered and aggregated. From this, projections of the increase in demand are made that are lower than those projected by state agencies. A positive relationship between family income and residential water purchases is demonstrated, while certain differences appear in the elasticity of demand findings of the cross-sectional and time series models. This might indicate under which considerations certain projections should be carried out. In conclusion, it is pointed out that the study is only exploratory and points up many complexities in the entire urban water market. (Gargola-Chicago)
W69-00391

DEVELOPING AND MANAGING THE WATER RESOURCES OF N.Y. STATE.
New York State Water Resources Comm., Divison of Water Resources.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00393

URBAN DOMESTIC DEMAND FOR WATER: A KANSAS CASE STUDY,
Wisconsin Univ, Milwaukee, Wisconsin.
Manual Gottlieb.
Land Economics, Vol. 39, No. 2, pp 204-210, May 1963, 6 pp, 2 fig, 4 tab, 20 ref.

Descriptors: Economies of scale, *Elasticity of demand, Water rates, Water consumption, Pricing, *Regression analysis, *Water demand, *Municipal water, Water requirements, Economics.
Identifiers: Kansas City, Mo., Income elasticity.

Discussed are the demand characteristics for domestic use of purified water produced and distributed by urban water works. Four specific points are reviewed; (1) price variance, (2) price elasticity, (3) effect of price change and (4) multiple regression analysis. It is tentatively shown that price elasticity is related to income elasticities, and that a price change temporarily depresses consumption. The actual price elasticity for water on grounds of National and Kansas data is approximately .4 for large cities and .65 for smaller communities. Because of lack of data for overall National consumption, however, these results cannot be certain. (Gargola-Chicago)
W69-00394

6E. Water Law and Institutions

RONDESVEDT V RUNNING (OWNERSHIP OF ALLUVION).

19 Wis 2d 614; 121 N W 2d 1-6 (1963).

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Descriptors: *Judicial decisions, *Wisconsin, Riparian rights, *Accretion (Legal aspects), Water law, Legal aspects, Relative rights, Riparian land.

Plaintiff Rondesvedt and defendant Running both claimed title to the top of a sand point, formed by accretion, which was contiguous only to Rondesvedt's land, but which ran laterally along the shore in front of Running's land. Rondesvedt brought an action to determine title to this land. The court found that if the accretion continued, defendant's access to the deep waters of the lake would eventually be cut off. It then decided that the boundary between the property of Rondesvedt and that of Running should be extended so that it cut across the point and that Running should have title to that portion of the point on her side of the boundary line. On appeal to the Supreme Court of Wisconsin, held, affirmed. The court stated that the general rule that alluvion belongs to the owner of land to which it attaches itself must give away when the rights of other riparian owners would be destroyed by such rule. (R. F. Williams-Fla)
W69-00003

BOLLINGER V HENRY (RIPARIAN RIGHTS ON ARTIFICIAL STREAMS).
375 S W 2d 161-166 (Mo 1964).

Descriptors: Missouri, Judicial decisions, *Artificial watercourses, *Riparian rights, *Prior appropriation, Boundary disputes, Mills, Irrigation water, Reasonable use, Streams, Relative rights, *Ownership of beds.
Identifiers: *Millraces, Adverse possession.

This was an action by owners of a millrace against the owner of adjoining land to quiet title and to obtain an injunction to prohibit the adjoining owner from taking water from the millrace. Several years before this action plaintiffs requested permission from the defendant to alter the millrace. Defendant agreed and a sharp curve in the millrace was eliminated by cutting the millrace through defendant's land. Defendant asserted a right to take water from the millrace at this point. Plaintiffs contended that their use of the millrace was open and notorious for several years and that as such gives them title to the altered section by adverse possession. It was held that plaintiffs had not acquired title to the property, and although the normal rule is that riparian rights do not attach to artificial streams, the rule was altered here. It was held that since the parties had not defined their respective interests in the water, the court could do so, and defendant was allowed reasonable access to the millstream. (Crabtree-Fla)
W69-00005

KLAIS V DANOWSKI (TITLE TO LANDS UNDER THE GREAT LAKES).

373 Mich 262; 129 N W 2d 414-423 (1964).

Descriptors: *Michigan, Judicial decisions, *Riparian rights, *Accretion (Legal aspects), *Boundary disputes, Ownership of beds, Great Lakes, Water law, Boundaries (Property), Eminent domain, Riparian land.

This case involved a purchaser's action on a land contract in which the State intervened. The State claimed that the land in question was part of State-owned, unpatented, submerged lands of the Great Lakes and, as such, was subject to legislation providing that occupants on such land may apply to the State for conveyances of its interests. The defendant claimed that the land was patented and hence the statute did not apply. The court agreed with the defendant. Since the land was patented before Michigan's admission into the Union, the U S had no title to pass at that time. The court also held that title of the riparian owner follows the shoreline; and as to accretions, relictions, avulsions or erosions on the Great Lakes, owners of lands bordering on the navigable waters thereof, patented to their ancestors in title by the U S, gain by what comes through accretions and reliction but do not lose that which they own under patent by erosion or avulsion. The right to acquisitions through accessions or reliction was said to be a riparian right, the taking of which by the State requires compensation. (Patterson-Fla)
W69-00007

PARKER V ADAMSON (ARE SAND SLOUGHS WATERCOURSES).
109 Ga App 172; 135 S E 2d 487-491 (1964).

Descriptors: Georgia, Judicial decisions, Boundary disputes, Boundaries (Property), Low water mark, Navigable waters, Non-navigable waters, Lakes, Streams, Ownership of beds, Perennial streams.
Identifiers: *Sand sloughs.

This was an action to determine the true dividing line between two properties in relation to a sand slough. The central issue was whether or not the slough should be considered non-navigable watercourse or whether it was a lake or pond. The boundary line along a non-navigable stream is the center line and along a lake or pond the boundary line is the low water mark. There was evidence that the sand slough was dry several months a year but had water flowing through it to a river during the rest of the year. It was held that the slough was a watercourse and that the center of the stream was the boundary line. Besides evidence as a perennial flow, the court found a slough to be a side channel of a river, and held that the name given a body of water is a material factor in determining its nature. (Crabtree-Fla)
W69-00008

SCHRODER V BATTISTONI (EASEMENTS TO ERECT DOCKS).

199 A2d 10-13 (Conn 1964).

Descriptors: Connecticut, Judicial decisions, *Prescriptive rights, *Easements, *Docks, Ownership of beds, Lakes, Riparian rights, Recreation, Right-of-water.

This was an action to enjoin interference with plaintiffs' use of docks extending from their property into defendant's lake. Plaintiffs claimed easements to erect and maintain their docks. It was found that their grantor did not intend to convey such an easement, the easements were not necessary for use and normal enjoyment of their lots, and prescriptive rights were not acquired because the dock use was neither adverse nor of sufficient duration. (Crabtree-Fla)
W69-00009

STATE V MAAS AND WALDSTEIN CO. (PRESCRIPTIVE RIGHTS IN NAVIGABLE WATERS).
83 N J Super 211; 199 A 2d 248-254 (1964).

Descriptors: New Jersey, Judicial decisions, Streams, Navigable waters, *Condemnation, *Highways, High water mark, *Ownership of beds, *Eminent domain, Prescriptive rights, Federal-state water rights conflicts, Riparian rights.

This was a condemnation proceeding to acquire a fee simple in a portion of defendant's lands fronting on the bank of a navigable river. Defendant claimed that the land under the river was not subject to condemnation because: (1) since the condemnation was not in furtherance of navigation and the highway department can only condemn such land for that purpose; (2) federal approval must be obtained for such takings; and (3) defendant had a prescriptive right in fee to the land. Each contention was denied. It was held that federal approval had been acquired, the state had power to condemn, and that title by prescription cannot be obtained against public lands. (Crabtree-Fla)
W69-00010

WEAVER V KNUDSON (TITLE TO UNMEANDERED LAKE SHORE LAND).
State of Wisconsin.

23 Wis 2d 426; 127 N W 2d 217-221 (1964).

Descriptors: Wisconsin, Judicial decisions, Shores, Survey, Boundaries (Property), High water mark, Lakes, Riparian land, Ownership of beds, Patents, Navigable waters.
Identifiers: Meander lines.

This was an action to quiet title. The land in question was conveyed by government patent according to the official plat. Plaintiffs were grantees of a certain Lot 7 which was split by a large lake. The land in question was a small piece of land across the lake from most of Lot 7. Defendants claimed that while the official plat included the small piece of land, the lake had not been meandered, and under the system then in effect, the patent should be held to include only the larger part of Lot 7. This result was urged because the government would not have intended to convey two unconnected parcels of land as one Lot. It was held that the Government patent should prevail on its face, and title was quieted to plaintiffs. (Crabtree-Fla)
W69-00014

TRUSTEES OF INTERNAL IMPROVEMENT FUND V TOFFEL (ACCRETION AS IT RELATES TO TITLE).

145 So 2d 737-745 (Fla D C A 1962).

Descriptors: Florida, Judicial decisions, Meanders, *Accretion (Legal aspects), High water mark, *Surveys, Relative rights, *Boundaries (Property), Rivers, Prescriptive rights, Riparian land, Public lands, Navigable waters, Ownership of beds.
Identifiers: *Meander line.

This was an action to quiet title to land along the Peace River. The disputed land was the subject of a federal survey in 1849 and was conveyed by patent in 1856. In 1939 the federal government resurveyed the land and claimed that the 1849 survey was invalid as to 386 acres, the land in issue. Plaintiff claimed that the original survey was substantially correct, and that accretion since 1849 accounted for much of the disputed 386 acres. Plaintiff further claimed that unless the surveys were fraudulent or grossly erroneous, that accretion along the navigable river should be his. Defendants claimed title to the 386 acres by patent from the United States after the 1939 survey. They claimed that the 1849 survey was gross error, and that the land in question was never conveyed by the United States under the original patent based on the 1849 survey. It was that the 1849 survey was valid and that accretion since that date accounted for the 386 acres. (Crabtree-Fla)
W69-00016

GIES V FISCHER (BULKHEAD LINES).

146 So 2d 361-364 (Fla 1962).

Descriptors: *Florida, Judicial decisions, Legislation, Navigation, Cities, *Ownership of beds, *Bulkhead line, Local governments, Condemnation, Riparian land, Public lands.
Identifiers: *Servitudes, Commerce.

This case was a proceeding challenging the constitutionality of Florida Statute 253.122 which authorizes local governments to fix offshore bulkhead lines. The statute was held constitutional. The statute was found to authorize establishment of bulkhead lines only at a point where further outward extension would constitute an interference with the servitude in favor of commerce and navigation. (Crabtree-Fla)
W69-00017

FORD V TURNER (ACCRETION, AVULSION, AND LAND TITLES).

142 So 2d 335-342 (Fla DCA 1962).

Descriptors: Florida, Judicial decisions, Hurricanes, *Accretion (Legal aspects), *Avulsion, *Boundary disputes, Navigable waters, Boundaries (Property), Islands, Prescriptive rights.

This was an action to quiet title to land formed by accretion along navigable water. It was held that such title is in the owner of the land to which there is an accretion. It was further held that subsequent severance by avulsion would not affect the title of non-submerged lands where such title was established prior to the severance. (Crabtree-Fla)
W69-00018

COMMONWEALTH V MAYER (LAKES--LEGAL ASPECTS).
357 S W 2d 879-882 (1962).

Descriptors: *Kentucky, *Lakes, Lake beds, Lake shores, State governments, Riparian land, *Legal aspects, Water law, Reasonable use, Dams, Permits, Water resources, Recreation, Project purposes, Conservation.

Merchant was granted permission by the Commonwealth of Ky to build a causeway across a neck of the lake wholly on state property but connecting a 21 acre tract which he owned on one side to a 45 acre tract owned by his mother on the other side of the lake. It was provided that Merchant should pay for building and maintaining the causeway, that it must be kept open to the public at all times, and it must be built according to county road standards. The Commonwealth owns both the lake and the access area on each side where the causeway in question is being constructed. The trial court held the causeway created a public nuisance and entered judgment ordering the removal of that work which had already been done and permanently enjoining any such project in the future. This court reversed the trial court and held that the fact the appellee's land may be ciminished in value to some extent by the erection of the causeway was not justification of prohibiting its construction. (R. Smith-Fla)
W69-00022

JEFFREY V GROSVENOR (ADVERSE POSSESSION OF RIVER BOTTOM LAND).
157 N W 2d 114-123 (Iowa 1968).

Descriptors: *Ownership of beds, *Accretion (Legal aspects), *Channel flow, Missouri River, *Iowa, Navigable rivers, Riparian rights, Stream beds, Bank erosion, Boundaries (Property), Avulsion, Bank stabilization, River flow, Islands, Beds, Meanders.
Identifiers: High water mark.

Action was brought to quiet title in plaintiff, the record title holder of Missouri River bottom land. The river by its meandering submerged the land which later reappeared when the river moved by avulsion. The shift of the channel left chutes bounding the property. However, since these were not normal channels, the land failed to conform to the concept of an island as a body of land emerging from a stream and completely surrounding by channels. Application of avulsion principles would require that the river suddenly shift, cutting off a body of land identifiable as property which existed before the shift. In this case the land was completely submerged, thereby losing its identity. Since the defendant had not held the land by open and continuous possession for 10 years, he could not claim title by adverse possession. (Rives-Fla)
W69-00026

DENEERGAARD V DILLINGHAM (LICENSE TO TAKE FROM ANOTHER'S SPRING).

187 A 2d 494-499 (Vt 1963).

Descriptors: *Vermont, *Springs, Boundary disputes, Permits, Water law, Legal aspects, Judicial decisions.

The case involved an action for a reformation of the plaintiff's deed to a parcel of land so that three springs would be within its boundaries. The lower court reformed the deed, but included only one of the springs within the plaintiff's property. The court in the instant case upheld the lower court after a review of the facts and the law of reformation of instruments. As to the plaintiff's claim of the existence of a lincense to take water from a spring that was not included within his property, the court held against him. The court stated that a license to take water from a spring can come into being only by the consent of the owner of the land where the spring is located, although consent may be inferred from circumstances indicating tacit consent or acquiesence. However, the plaintiff did not carry his burden of proof in this matter. The decree of the Chancellor was therefore affirmed. (Patterson-Fla)
W69-00035

GREEN V ELDRIDGE (NAVIGIBILITY TEST IN MARYLAND).
230 Md 441 187 A 2d 674-678 (1963).

Descriptors: *Maryland, *Navigable waters, *Ownership of beds, *Water law, Watercourses (Legal), Judicial decisions, Boundaries (Property), Marshes, Streams.
Identifiers: Public trust doctrine.

This case involves a suit for an injunction and money damages for making more difficult the construction of a roadway the plaintiff alleged he was entitled to build by virtue of a deed from his predecessor in title. It was claimed that the deed conveyed fee simple title to a strip through a creek and marsh upon which the plaintiff desired to construct the road. The Chancellor found that the deed in question granted the plaintiff only an easement; since the creek and marsh were navigable, the bed was owned by the state. The central issue is whether the Chancellor erred in determining the creek and marsh to be navigable. The court in the instant case agreed with the Chancellor. After a review of the cases, the court stated that the waters were navigable under both the old ebb and flow of the tide test and under the more recent navigability in fact test. Traffic of smaller boats was sufficient to establish navigability, since it is not necessary to a stream's being navigable that it be capable of carrying large vessels, or supporting commercial traffic. (Patterson-Fla)
W69-00037

STATE V MCDONALD LUMBER (LAKES SHORES).
State of Wisconsin.

18 Wis 2d 173; 118 N W 2d 152-154 (1962).

Descriptors: Wisconsin, Lakes, *Ownership of beds, Excavation, *Lake beds, Legislation, Landfills, Boundaries (Property), *High water mark, State governments, Accretion, *Lake shores, Riparian land, Water law.

The property in question is located at the shoreline of Green Bay just east of the mouth of the Fox River. The city of Green Bay deeded part of this property to the defendant. In 1957, the defendant applied to the Army Corps of Engineers for a permit to construct a dock and slip east of the mouth of the river. The defendant also requested a state permit for this project. Although the Army issued a permit, the state did not. The trial court found the defendant guilty of excavating and filling part of the lake bed without first obtaining permission from the state. The court enjoined the defendant from filling further out into the water but refused to order abatement of the alleged nuisance and also refused to grant an injunction against continuance of unauthorized excavation and trespass. In affirming the trial court, the court held the state had not supported its burden of accurately proving the old shoreline of the lake and was not entitled to injunctive relief. (R. Smith-Fla)
W69-00039

STATE V RAYMOND (LEGAL ASPECTS OF ACCRETION).
119 N W 2d 135-140 (Iowa 1963).

Descriptors: Riparian rights, Navigable waters, Ownership of beds, *Riparian land, Water law, *Accretion (Legal aspects), *Islands, Missouri River, High water mark, Iowa, Aerial photography, Charts, Channel improvement, Diversion, Flow control, Vegetation, Iowa.

All the parties to this action agreed that the land in question formed as accretion. The plaintiff claimed it developed in the form of an island that arose in the bed of the Missouri River commencing in 1938. The defendants contended the property formed as a direct accretion to their riparian lands commencing in 1939, and remained joined to their land until the 1943 flood. The parties did not disagree on the title to land so formed or the rules of law applicable to questions of accretion. The issue before the court was solely a question of fact. The court reviewed the evidence before the trial court and affirmed its decision that the land developed as an island. (R. Smith-Fla).
W69-00040

PARISH V SPENCE (SURVEY SHORELINE BOUNDARIES).
149 So 2d 58-65 (Fla DCA 1963).

Descriptors: *Survey, Water law, Meanders, *Boundaries (Property), *Streams, Accretion, Florida, Bayous, Topography.
Identifiers: Dependent resurvey.

Plaintiffs have appealed from a summary judgment for defendants. The issue before the court was whether the trial judge erred in ruling that the plat of the 1932 survey, together with the field notes were inadmissible. Defendants contend that the U S Government conveyed title to Lot 6 and 7 in accordance with the original survey as shown by the 1826 plat. They emphasize that Juniper Creek is delineated on the original plat which affirmatively establishes that no part of Lot 7 lies westerly thereof or westerly of Boggy Bayou which formed a natural boundary between the southern portion of the two lots. It is defendant's position that the purpose and effect of the dependent resurvey of 1932 is to show an easterly shift in the southerly course of Juniper Creek and a southwesterly recession of Boggy Bayou thereby changing the boundary line between lots 6 and 7. The court set aside the summary judgment and ordered that the dependent resurvey of 1932, and the field notes from which the plat was prepared be admitted into evidence for the purpose of proving the issues in the case. (R. Smith-Fla)
W69-00045

WAGGENER V LEGGETT (TRESPASS TO LAND - DREDGING AND CAVE-IN).

150 So 2d 529-531 (Miss 1963).

Descriptors: *Mississippi, *Dredging, *Damages, Legal aspects, Judicial decisions, Boundaries (Property).

The plaintiffs brought an action for trespass to land against the defendants, who allegedly dredge soil from the bottom of a bayou and thereby removed part of the plaintiff's shoreline and caused a cave-in. The court in the instant case upheld a ruling of the trial court judge to the effect that where diminution of the permanent value of the land is less than the cost of restoration, an instruction requiring the jury to apply the before-and-after rule, ie, measurement of permanent damages by the difference in the value of the land before and after the trespass, is proper. (Patterson-Fla)

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W69-00047

LOPEX V SMITH (THE EFFECT OF NAVIGABILITY ON BOUNDARY DETERMINATION).
145 So 2d 509-522 (Fla DCA 1962).

Descriptors: Florida, Judicial decisions, Navigation, Navigable waters, *Boundary disputes, Meanders, *Surveys, Patents, *High water mark, Boundaries (Property).

This was an action to establish ownership of certain island property. The issue was whether the rivers in question were navigable and if so, had been at statehood. It was found that the river had been navigable since statehood, and therefore, boundaries in question were to be determined by highwater marks rather than by meander lines. Navigation was defined in terms of useful purpose, stating that a river is navigable at law if it is navigable in fact. (Crabtree-Fla)
W69-00048

BEDINGFIELD V WATSON (PROPERTY BOUNDARIES).
147 So 2d 458-462 (La 1962).

Descriptors: Federal government, State governments, Louisiana, Navigable waters, Water law, *Boundaries (Property), Lakes, *Lake shores, Surface waters, Legal aspects, *Contours, Land, Land tenure.

The property in question was located below the 148.6 foot contour line of Lake Bistineau. It was acquired by the State of La upon its admission into the Union as a state, since Lake Bistineau was, in 1812, a navigable stream. The plaintiff alleged ownership of the land in question. The defendants denied this allegation and claimed ownership of the same property on the basis of inheritance from their ancestor-in-title or in the alternative, that they acquired ownership by prescription. The court held that since the defendant's chain originated in a title from the United States Government, it did not extend below the contour line. The defendants claim to the property must therefore, be predicated solely on their plea of acquisitive prescription. The court affirmed the trial court and concluded that the defendants did not establish such possession as owner for the requisite 30 years as would entitle them to acquire title thereto under their plea of prescription. The court held the plaintiffs were the owners of the property in question. (R. Smith-Fla)
W69-00049

THORNHILL V SKIDMORE (EASEMENTS OF ACCESS TO CANALS).
227 N Y S 2d 793-801 (1961).

Descriptors: New York, Judicial decisions, *Access routes, Recreation, *Artificial watercourses, *Canals, *Easements, Taxes, Right-of-way, Community development, Public rights, Prescriptive rights.
Identifiers: Tax title.

This case concerned the plaintiff's right of access to a canal. After first holding that there are no public rights as to an artificially created canal, the court held the purpose of an open area at the end of the canal which was never conveyed out by developer was to afford access to canal to the owners of lots not abutting the canal, and that a tax title conveying such open area to a purchaser at a tax sale from an 'unknown owner' did not operate to relieve the open area of the burden of the easement. (Crabtree-Fla)
W69-00050

VILLAGE OF OLD FIELD V SCHUYLER (DREDGING STATE SOIL IN RIVER BEDS).

16 A Div 2d 496; 229 N Y S 2d 710-714 (1962).

Descriptors: New York, Judicial decisions, *Ownership of beds, Permits, *Dredging, Flood protection, Channel improvement, Beach erosion, State governments, Legislation, Storms, *Bank erosion, Avulsion.

This was a proceeding on a petition to review and annul a license to dredge on state land under water. It was held that the statute authorizing removal of soil from state land under water was intended only to permit an upland owner to improve or protect property or to remedy or prevent shoreline erosion from the action of water or to restore soil washed away by violent storm and consequent avulsion, and that it did not authorize a license to dredge so as to permit a dredging barge to enter to deepen a pond. (Crabtree-Fla)
W69-00051

SCHULZ V CITY OF DANIA (PRESUMPTION OF EROSION).
156 So 2d 520-522 (Fla D C A 1963).

Descriptors: *Judicial decisions, *Florida, *Avulsion, *Erosion, Beach erosion, Beaches, Cities, Relative rights, Riparian rights, Oceans, Water law, Legal aspects.
Identifiers: *Presumption of erosion, *Burden of proof.

Defendant owned a lot originally bounded by the Atlantic Ocean on the east and by plaintiff's land on the west, but which had become submerged under the ocean. Plaintiff city brought a quiet title suit to have vested in itself and its assignee all of the riparian rights incident to its ownership of riparian land. The trial court found that the land had become submerged due to erosion, thereby causing the title to revert to the state, and entered the decree prayed for. Defendant contended on appeal that since the city instituted the suit, the burden of proof was on it to prove that the disappearance took place by erosion, and that this was not satisfied. The District Court of Appeal affirmed the decree, holding that there is a presumption that land disappears by erosion, thereby divesting the owner of title, as opposed to avulsion, not resulting in such divestment. Once plaintiff proved the land had disappeared, the burden shifted to defendant to prove by a preponderance of the evidence that the disappearance was a result of avulsion. (R.F. Williams-Fla)
W69-00054

CITY OF NORTHLAKE V CITY OF ELMHURST (PRESCRIPTIVE RIGHTS: DISCHARGE OF SEWAGE).
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00055

DEATON V CAUSEY (SURFACE WATER DRAINAGE - PRESCRIPTIVE PERIOD).
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00056

ZABEL V WATER AND NAVIGATION CONTROL AUTHORITY (DREDGE AND FILL PERMIT REJECTION).

154 So 2d 181-188 (D C A Fla 1963).

Descriptors: *Florida, *Water law, *Administrative decisions, *Landfills, Riparian rights, Legislation, Dredging, Beds, Permits, Public rights.
Identifiers: *Constitutional law, Public trust doctrine, Sovereignty lands.

Plaintiffs petitioned defendant Pinellas County Water and Navigation Control Authority, pursuant to Florida statutes, requesting that it fix a bulkhead line and grant them a dredge and fill permit for 11.5 acres of their bottom land in Boca Ciega Bay. The Authority refused the permit, and on appeal, a lower court affirmed the Authority's ruling as well as holding that the plaintiffs were estopped from challenging the constitutionality of the statutes under which they were seeking relief. The court in the instant case, after a review of the evidence, held that it was sufficient for the authority to determine that there would be material adverse effects as a result of the proposed fill. Thus there was cause for withholding a permit. The court noted statutes dealing with establishment of bulkhead lines and the Authority's power to regulate dredging and filling. As to the constitutional issue, the court overruled the lower court's holding that plaintiffs were precluded from challenging the constitutionality of the operative legislation. However, it upheld the legislation as it was applied in the instant case. (Patterson-Fla)
W69-00057

VAN BROCKLIN V GUDEMA (WELL WATER POLLUTION CAUSED BY NEGLIGENCE OF ADJOINING FARMOWNER).

199 N E 2d 457-462 (111 1964).

Descriptors: *Water wells, Water pollution, Drainage effects, Surface runoff, Groundwater, Drainage water, Bacteria, *Water pollution effects, Taste, Illinois, Judicial decisions, Damages, Color.

The litigants owned adjoining farm property. Defendant placed a large pile of manure on his property but in close proximity to the plaintiff's well. Rain water passing over the manure contaminated the water in plaintiff's well. Plaintiff and his family lost the use of the well for over eight weeks. He recovered damages for the inconvenience and discomfort caused by the temporary loss of water supply that resulted from the negligence of defendant. The appellate court agreed that inconvenience and discomfort are proper elements of recovery. Evidence of specific pecuniary damage need not be adduced. (Harriett-Fla)
W69-00058

TOWN OF SOMERSET V DIGHTON WATER DIST (LEGISLATION ON DIVERTING WATER SUPPLY).
200 N E 2d 237-240 (Mass 1964).

Descriptors: Public rights, Competing uses, Eminent domain, *Legislation, Project planning, Governments, Water law, Water rights, Water resources development, Riparian rights, Watersheds (Basins), *Water supply, Rivers, Surface waters, *Water wells, Pumping, Massachusetts.

In 1961 the plaintiff, because of an acute need for additional water supplies, initiated several steps to enlarge its water supply by diverting the waters of the Segreganset River to an off-stream reservoir. These steps included the authorization of plaintiff's treasurer to issue bonds in order to raise additional money. However, no formal order of taking of the reservoir land has been made or recorded. Pursant to this plan, the plaintiff entered into an agreement with Montaup to purchase some sixty acres of land in Dighton at the lowest riparian locus to the river. On August 30, 1962, the defendant's commissioners held what they declared to be an emergency meeting to adopt and record an order taking the waters of the Segreganset, before the plaintiff could obtain and record a deed from Montaup and before a restraining order freezing the status quo could be obtained. On the basis of a construction of the word 'appropriated' within the meaning of the Mass statutes, the court held the defendant's purported taking of the waters null and void. (R. Smith-Fla.)
W69-00059

WILLIAMS V PENDLETON MFG CO (WATER POLLUTION IN NONNAVIGABLE CREEK).
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00060

ST MARY PARISH CO V STATE MINERAL BD (MINERAL LEASES OF WATER BEDS).
167 So 2d 509-517 (La 1964).

Descriptors: *Louisiana, *Judicial decisions, Beds, Beds under water, *Ownership of beds, Lakes, Water law, Administrative agencies, Legislation.
Identifiers: *Possessory action, Mineral leases.

This was a possessory action by a land company against the state mineral board to be recognized and maintained in possession of water bottoms in certain sections. Plaintiff's land was interspersed with water ways and lakes. The purpose of this action is to determine whether plaintiff or defendant has the right to grant mineral leases of the beds of the waters on plaintiff's land. The State of Louisiana was not joined as a party. Plaintiff seeks the benefit of a statute permitting possession of the whole of a tract without actual physical possession of every part of the tract. (Possession only, not title, is before this court.) The court found that plaintiff had regularly patrolled the area, granted an electric transmission right of way across the area, and drilled wells in the area, hence was in possession and entitled to benefit of the statute as to the disputed water bottoms. The court ordered defendant, as agent of the state, to assert any claim of ownership of the bottoms within 60 days. (Kirkconnell-Fla)
W69-00061

CITY OF DEMOPOLIS, ALABAMA V UNITED STATES (COMPENSATION FOR FEDERAL DAM PROJECTS).

334 F 2d 657-660 (Ct Cl 1964).

Descriptors: *Judicial decisions, *United States, Federal government, *Rivers and Harbors Act, *Navigation, Compensation, Water law, Legal aspects, Rivers, Cities, Sewage disposal, Municipal wastes.

Plaintiff was an incorporated city in Alabama which since 1904, had used a gravity sewage system to empty its raw sewage into the Tombigbee River, admittedly navigable. Pursuant to the Rivers and Harbors Act, the defendant Federal Government built a dam downstream from plaintiff city. This retarded the flow of the river and created a lake. The State of Alabama then required plaintiff to build a treatment plant for its sewage. Plaintiff estimated that the cost of such new system would be $950,052 and sued the Federal Government on the ground that its present system had been seized without compensation. The Court of Claims denied recovery. The rights of a riparian owner are subject to the paramount right of the federal government to improve navigation. This right extends up to the ordinary high water mark, which was above plaintiff's sewage outlet. The court does state that recovery may be had for flooding of municipal land above the high water mark. (R.F. Williams-Fla)
W69-00062

BRAUN V FOXBORO CO (DISCHARGE OF SURFACE WATERS).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00063

BAKER V RINAKER (OBSTRUCTION TO NATURAL FLOW OF SURFACE WATERS).
195 N E 2d 755 (Ill 1964).

Descriptors: Illinois, *Surface waters, Streams, *Obstruction to flow, Natural flow doctrine, Judicial decisions, *Landfills.

In an action for a mandatory injunction to require defendants to remove a man-made obstruction to the natural flow of water from plaintiff's land wherein defendant counterclaimed to restrain plaintiff from diverting surface water, sustained evidence finding that fill and structures placed on defendants' land did not in fact obstruct the natural flow of surface waters from plaintiff's land, and that plaintiff had diverted surface water onto defendant's farm. (Crabtree-Fla)
W69-00064

SCOTT V SLAUGHTER (LOWER RIPARIAN RIGHTS V UPPER RIPARIAN RIGHTS).
373 S W 2d 577-580 (Ark 1963).

Descriptors: Arkansas, Hunting, Fishing, Streams, Riparian rights, *Reasonable use, *Dams, *Appropriation, Commercial fishing, Reservoirs, *Preferences (Water rights), Priorities, Judicial decisions.
Identifiers: Commercial hunting.

The upper riparian defendant built three dams which lowered the streams flowing through lower riparian plaintiff's land. Defendant and plaintiff operate commercial hunting and fishing facilities on their respective premises. Plaintiff argued that defendant's impoundments constituted an unreasonable use of the water. Held, the right to use water for domestic purposes is superior to other uses, but other than domestic purposes, all other lawful uses are equal. When one lawful use is destroyed by another lawful use, the second must yield or may be enjoined. However, as in the instant case, reasonable and equitable adjustment may be made. Here, defendant was required to lower the dams partly in order to allow plaintiff enough water to reasonably meet his commercial needs. (Crabtree-Fla)
W69-00065

ASSOCIATED CONTRACTORS STONE CO V PEWEE VALLEY SANITARIUM AND HOSPITAL (LIABILITY FOR ALTERING UNDERGROUND WATERS).

376 S W 2d 316-319 (Ky 1963).

Descriptors: Water pollution, Kentucky, *Explosions, Underground streams, Percolating water, *Excavation, Obstruction to flow, Judicial decisions, Reasonable use, Quarries, Rock excavation.
Identifiers: *Nuisance (Legal aspects).

Plaintiff's lands bordered or were close to defendant's property. Defendant planned blasting operations. Plaintiffs objected partly on the grounds that underground streams and percolating waters would be altered and result in damage to plaintiffs. The court found that assuming reasonable and legitimate use, the owner is not liable to adjoining owners for injuries to wells or springs fed by hidden underground streams or percolating waters. The case was decided for plaintiff on other grounds. (Crabtree-Fla)
W69-00066

GRAVES V WIMPY (COMMUNITY DRAINAGE DITCHES).

372 S W 2d 812-816 (Ark 1963).

Descriptors: Judicial decisions, Arkansas, *Drainage, Farm management, Repulsion (Legal aspects), *Ditches, *Obstruction to flow, *Permits, Prescriptive rights, Relative rights.

Where adjoining property owners, jointly constructed and used a portion of a drainage ditch from 1954 until 1962, and improvement was accepted and acted upon by both parties in their farming operations, each had a right, in the nature of a license, to the unobstructed use of the community ditch, and plaintiff was estopped from erecting a dam on another portion of the ditch when it had been used by defendant for drainage for four years and when such upper portion of the ditch had been constructed by defendant at his own expense. (Crabtree-Fla).
W69-00068

WILLIS V RICH (OBSTRUCTION OF DRAINAGE EASEMENT).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00069

TOWN OF HEMPSTEAD V LITTLE (LITTORAL RIGHTS).
20 App Div 2d 539; 245 N Y S 407-410 (1963).

Descriptors: *Judicial decisions, *New York, Water law, Legal aspects, *Condemnation value, Compensation, Cities, *Eminent domain, Avulsion, Cities, Reliction, Alluvion, Littoral, Beaches, Coasts.

In a prior condemnation proceeding, the town acquired title to land owned by the claimants. These lands consisted entirely of uplands, and it was found that the submerged portions had become submerged by avulsion. In the absence of the Town's condemnation, the owners would have retained title to the submerged land if it had once more emerged. When the town condemned the uplands, it also obtained littoral rights, making the fee title of claimants to the submerged lands subject to divestment in the event and to the extent of future alluvion or reliction. Therefore, claimants' unity of title to uplands and submerged lands lost by avulsion was broken when the town obtained the uplands and littoral rights, and an award in this subsequent condemnation suit based on use of several parcels including those to which the town had acquired littoral rights as a single unit was error. (R. F. Williams-Fla)
W69-00070

BROWN V ALABAMA POWER CO (BUILDING ENJOINED BY OWNER OF FLOWAGE EASEMENT).
156 So 2d 153-157 (Ala 1963).

Descriptors: *Judicial decisions, *Alabama, Remedies, *Easements, Water law, Water rights, Flood damage, Real property, Flooding.
Identifiers: Flowage easements, Injunction.

The Alabama Supreme Court held that the erection of a house or cottage on land on which a power company owned a flowage easement or an easement to flood the land was rightly enjoined where water would cover a portion of the structure. The holder of an easement has the dominant estate; the owner of the servient estate can be enjoined from performing acts which interfere with the proper enjoyment of the easement. That an obstruction of an easement is of minor degree furnishes no standard for justification if the obstruction clearly interferes with the enjoyment of the easement. (MacMillan-Fla)
W69-00071

KIDWELL V BAY SHORE DEVELOPMENT CORPORATION (OBSTRUCTION TO FLOW TO SURFACE WATERS).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00072

MILLER V SOMMERS (OBSTRUCTION TO SURFACE DRAINAGE).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00073

PURNELL V HOCK (OBSTRUCTION TO FLOW BY LOWER OWNER).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00074

TOWN OF ASHWAUBENON V PUBLIC SERV COMM'N (BULKHEAD LINES IN NAVIGABLE

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WATERS).

22 Wis 2d 38; 125 N W 2d 647-656 (1964).

Descriptors: Wisconsin, *Bulkhead lines, Shores, Navigation, Cities, Navigable waters, Judicial decisions, Piers, *Ownership of beds, State jurisdiction, *Submerged lands act.
Identifiers: *Trust Theory.

The issue here was the construction of a bulkhead line by a city which would require filling of a navigable river. It was held that the Trust Doctrine pertaining to navigable water does not preclude private structures and fill in beds of navigable rivers where the state legislature has expressly invited such physical interjection. Riparian owners have only qualified title to the beds of navigable rivers and title of the state is paramount; the rights of others are subject to revocation at the pleasure of the legislature. (Crabtree-Fla)
W69-00075

TAYLER V WEST VIRGINIA PULP AND PAPER CO (NAVIGABLE STREAMS).

262 N C 452; 137 S E 2d 833-837 (1964).

Descriptors: *Judicial decisions, *North Carolina, Water law, Legal aspects, *Right-of-way, Easements, *Condemnation, Navigable rivers, Lumber.

Petitioner was the owner of timberland which was completely surrounded by respondent's tract. Petitioner proceeded to ask for condemnation of a cartway leading from his boundary to the respondent's private dirt roads, over which he might carry his timber. Respondent answered that petitioner already owned a right-of-way to a navigable stream, and it also tendered to petitioner the right to use a strip of its land to build a road connecting to a public highway. At trial the judge found that both alternatives open to the petitioner (navigable stream and the offer of an easement) met the requirement of a necessary and proper access to petitioner's land. On appeal to the North Carolina Supreme Court, held, affirmed. Evidence that logs had been transported on the stream ten years prior to this case was adequate to sustain a finding of navigability. If a stream is navigable in fact it is navigable in law, and if such stream provides an adequate means of ingress and egress, the landowner is not entitled to another over the land, even though it may be more economical and convenient. (R. F. Williams-Fla)
W69-00076

BELLVILLE V PORTER (ACCRETION AS IT RELATES TO MAINTENANCE).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00077

TIEDEMAN V VILLAGE OF MIDDLETON (SURFACE DRAINAGE BY SUBSURFACE DRAINS).
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00078

CARVALHO V LEVESQUE (WATER SUPPLY CONTRACTS).
191 A 2d 165-168 (R I 1963).

Descriptors: *Rhode Island, *Water Districts, Easements, Judicial decisions, Supply contracts, Ordinances, Statutes, Water delivery, Administrative decisions, *Water contracts, Future planning.

The issue here concerned a water districts, while under no obligation to do so, that entered into a water supply contract with plaintiff which provided for future suitable terms; the District subsequently refusing performance unless plaintiff executed a permanent easement to the District unrelated to plaintiff's water supply. It was held that since the District did not have to supply plaintiff, and in that the District was responsible for future water planning, the requirements of an easement was reasonable. (Crabtree-Fla)
W69-00079

WAGNER V TIDEWATER OIL CO (DAMAGE RESULTING FROM STREAM FLOW ALTERATION).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00080

NORMANOCH ASS'N INC V BALDASANNO (LAKE SHORES).
40 N J 113 190 A 2d 852-867 (1963).

Descriptors: Lakes, *Lake beds, *Lake shores, Boundaries (Property), Boundary disputes, Legal aspects, *Ownership of beds, Water law, Dams, Mill dams, Dam construction, Surveys, Mapping, On-site data collections.

This is an appeal by Normanoch from a judgment which dismissed its complaint demanding injunctive relief and damages against defendant for alleged trespass upon certain lands underlying Culvers Lake. Defendant denies Normanoch's title and claims title in himself. The issue was whether the Rutherfurd grant or the Niles deed encompassed the lands in question. The solution to this problem depends on the perimeter of the lake as it existed either at the time of the survey for the Rutherfurd grant on July 31, 1828 or at the recordation thereof on May 23, 1834, as Niles could have only obtained title to those lands which might now be submerged as were excepted from the Rutherfurd grant. Since the ultimate decision depended upon these two chains of title the court outlined the sequence of grants and conveyances. The court concluded that defendant had not presented sufficient evidence to rebut the presumption that the shore boundary had not changed between 1828 and 1882 nor had he disproved that Normanoch had title to the submerged lands. (R. Smith-Fla)
W69-00081

ALLEN V ATLANTA (SURFACE DRAINAGE).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00083

RECOMMENDED STATE LEGISLATION AND REGULATIONS.
Dept. of Health, Education and Welfare, Public Health Service.

Public Health Service, July 1965, 109 pp, 7 tab.

Descriptors: *Legislation (Laws), Well regulations, Sewerage disposal, Water supply.

The 'Urban Water Supply and Sewerage System Act' provides for the development of an official community plan for water and sewerage systems consistent with the needs of the area and for the control of installations. The 'Water Well Construction and Pump Installation Act' regulates the development of ground water systems and the location, construction, repair, and abandonment of water wells, and the installation and repair of pumps and pumping equipment to assure protection against possible contamination and to maintain a safe and potable water supply. The 'Individual Sewerage Disposal Systems Act' regulates the design, construction, installation, operation and maintenance of individual disposal systems and the proper planning thereof. The lack of legislation to regulate individual water supply and sewerage disposal in urban areas can create significant public health problems; the study recommends such acts be adopted to facilitate an orderly development of the water supply. (Gargola-Chicago)
W69-00177

RIGHTS OF THE STATES IN THEIR NATURAL RESOURCES PARTICULARLY AS APPLIED TO WATER,
South Carolina Univ., Columbia.
Dudley W. Woodbridge.
S C L Q, Vol 5, No 2-A, pp 130-140, Dec 1952. 11 p, 46 ref.

Descriptors: Water resource development, *State governments, Interstate, Federal government, *Federal-state water rights conflicts, Riparian rights, Equitable apportionment, Relative rights, Clouds, Cloud seeding, Groundwater, Surface water, Ownership of beds, Navigable waters, Percolating water, Water law.

As a result of the Revolution the people of each state became sovereign, and in that capacity acquired the rights of the crown in the public domain. The author describes in detail that although the states own their navigable waters this ownership is subject to the commerce power, the war power, the proprietary property rights, the treaty making power, the general welfare power of the federal government, the doctrine of equitable apportionment where the stream is an interstate one, and to any interstate compacts that have been made as well as the rights of riparian owners. It is also stated that the ownership of the states' navigable waters has a double aspect - the public right and the private right. To the extent that a state owns its navigable waters and the beds of streams in its private right it may alien the same as any owner. But to the extent that a state owns its public right it holds in trust for all its citizens and can grant no monopoly.
W69-00274

THE STATUS OF RIPARIAN RIGHTS IN CONNECTICUT,
Connecticut State Bar Assoc, Hartford.
T. Paul Tremont.
Conn B J, Vol 33, No 4, pp 430-439, Dec 1959. 10 p, 41 ref.

Descriptors: *Connecticut, *Riparian rights, *Docks, Public rights, Ownership of beds, Judicial decisions, Riparian land, Water law.
Identifiers: *Shoreland ownership, *Right to wharf, Public trust doctrine.

In Connecticut, the state owns land between the high and low water marks, holding it in trust for the people; however, the rights of the individual riparian owner on this land, called franchises, are in doubt. The basis of the riparian owner's franchise is the right to access, which is usually manifested through the right to erect wharves and piers. In the early 1900's, the right to wharf, which was liberally interpreted to aid developing economy, was expanded to the detriment of the public interest. One case went so far as to hold that riparian rights in the soil between the high and low water marks could not be taken for public use without compensation. However, the state is now asserting its valid interest in the public shorelands through statute and case law. The author urges that present public policy dictates closer adherence to the public trust doctrine.
W69-00275

WATER RIGHTS IN INDIANA.
Indiana State Bar Assoc., Bloomington.

Ind L J, Vol 32, No 1, pp 39-56, Fall 1956. 18 p, 11 ref.

Descriptors: *Riparian rights, Indiana, *Water law, Water resources development, Legislation.

Indiana water rights law is based on riparian rights doctrine and represents primarily a response of excess rather than water shortage. Comprehensive legislation is needed that would delineate private rights and create procedures for local organization and a favorable substantive law to encourage storage and other conservation measures. Indiana's legislative history in the area is discussed.
W69-00276

CRISIS, COMMUNITY AND CONSENT IN WATER POLITICS,
Duke Univ, Durham.
Henry C. Hart.
Law and Contemp Prob, Vol 22, No 3, pp 510-537, Summer 1957. 28 p, 1 fig, 90 ref.

Descriptors: *Water resources development, Administration, Federal-state water rights conflicts, *Political aspects, *Federal government, Government finance, River basin development, Planning, *State governments, Local governments, Cost sharing, Coordination, Multiple-purpose projects, Flood control, Dams, Water policy, Reservoirs.

This is a time, as this symposium shows, when many of us can be drawn into a re-examination of our approach to the government of water resources. We have failed to find viable answers to the problems of governing our water resources because we have been looking in the wrong places. We have looked to national departmentalization and executive organization, while the problem is basically one of public attention and interest. We have looked for assertions of policy, but the problem is one of discovering people's conscious needs. We have conceived of techniques as decisive and of the natural flow of water as embodying some human imperative, when its true human meaning is variety and diversity of potential. The water potentials which enlist human enterprise and decision over the years do not coincide, save by remote chance or by the most painstaking institutional arrangements, with states, cities or the nation. The author then proposes two alternative plans of future action to solve the above problem.
W69-00279

REPORT OF THE COMMITTEE ON MARINE RESOURCES.
American Bar Assoc., Chicago, Sect on Mineral and Natural Resources Law.

1967 Committee Reports, pp 226-250, 85 ref.

Descriptors: *Continental shelf, Continental slope, *Ownership of beds, Legislation, Administrative agencies, Submerged Lands Act, Beds, Oceans, State governments, Federal government, Water law, International law.
Identifiers: *Truman Proclamation of 1945, *Convention on the Continental Shelf, Outer Shelf Act.

The report, which covers background material and recent developments in the field of marine resources, is divided into 3 parts: (1) state marine resources; (2) federal resources; (3) international aspects of marine resources. The first part outlines items of interest in state-federal relations, geophysical and leasing activity, court decisions, departmental decisions, regulations and legislation occurring in the Atlantic, Gulf Coast and Pacific states. The second part investigates the Marine Resources and Engineering Development Act as background for 1966-1967 developments in federal marine resources, which include, inter alia, appointments to the Commission on Marine Science in the executive department and passage of the Clean Waters Restoration Act in the legislative branch. The final subdivision of the report focuses on: (1) the Truman Proclamation of 1945, which enunciated the legal concept of the continental shelf; (2) Congressional assertions of jurisdiction through the Submerged Lands Act and the Outer Shelf Act; and (3) the Convention on the Continental Shelf. The Convention defined the continental shelf as seabed adjacent to the coast to a depth of 200 meters or, beyond that, to a depth admitting of exploitation of natural resources.
W69-00285

JUDICIAL EXPANSION OF SEAWARD BOUNDARIES ABOVE SUBMERGED LANDS,
New York Univ. School of Law, New York.
Norman Frost.
N Y U Intra L Rev, Vol 16, No 4, pp 235-254, May 1961. 19 p, 84 ref.

Descriptors: *Submerged Lands Act, Judicial decisions, *Beds, *Ownership of beds, Federal government, State governments, Federal jurisdiction, State jurisdiction, Oil fields, *Continental shelf, Relative rights.
Identifiers: *Tidelands cases.

In U S v Louisiana and U S v Florida the Supreme Court held that under the Submerged Lands Act, the United States was entitled to all lands, minerals and other resources underlying the Gulf of Mexico more than three geographic miles from the coasts of Louisiana, Alabama, and Mississippi. Florida and Texas were allowed to set their boundaries at 10.5 miles from their coastlines. The Act's provision that a state's boundaries could exceed the three mile limit if they so existed 'at the time' they were admitted to the Union allowed this result. The vast supplies of oil and gas which have been discovered in the continental shelf precipitated the disputes. The 'tidelands' cases, holding that the United States was owner of the three-mile marginal belt, are discussed and criticized. The Submerged Lands Act was passed in 1953 to reverse the result of these cases. The Outer Continental Shelf Lands Act retained jurisdiction over the lands seaward of the state boundaries in the federal government. In conclusion, U S v Louisiana and U S v Florida are criticized.
W69-00292

REPORT OF THE COMMITTEE ON WATER RESOURCES.
American Bar Assoc., Chicago Sect. of Mineral and Natural Resources Law.

1963 Committee Reports, pp 158-186.

Descriptors: *Water law, *Legislation, *Judicial decisions, *Administrative decisions, Georgia, Minnesota, Water resources, Federal-state water rights conflicts, Federal government, State governments, Water management (Applied).

The report is divided into three parts, the first dealing with legal developments in the field of water resources in various states and the federal government for the period May 1962 through April 1963. These developments are discussed under the headings of legislation, judicial decisions and administrative action. Among the states reporting are Georgia and Minnesota. Significant federal developments include legislation affecting reclamation projects, coordinated watershed investigations and jurisdiction over interstate river pollution disputes. The second part consists of the first report of the Ground Water Management Subcommittee points out areas of concern that will be more fully developed in subsequent reports. Thirdly, a brief report on legislation relating to federal-state jurisdictional conflicts in water resources development is given.
W69-00298

REPORT OF THE COMMITTEE ON NATURAL RESOURCES.
American Bar Assoc., Chicago Sect on Mineral and Natural Resources Law.

1965 Committee Reports, pp 136-166, 26 ref.

Descriptors: *Water law, *Legislation, Judicial decisions, *Administrative decisions, Water resources, Minnesota, Federal-state water rights conflicts, Federal government, State governments, Water management (Applied).
Identifiers: Water Resources Research Act, Water Pollution Control Act.

The report is divided into three parts, the first dealing with legal developments in the field of water resources in various states and the federal government for the period May 1964 through April 1965. These developments are discussed under the headings of legislation, judicial decisions and administrative action. Although the states reporting are primarily in the western U S, Minnesota is included. Federal developments in the legislative area include enactment of the Water Resources Research Act and the Land and Water Conservation Fund. Among matters pending in the 89th Congress are Federal Water Pollution Control Act amendments, river basin planning proposals, and the Federal Water Projects Recreation Act. Administrative action taken by the Interior department and the Federal Power Commission is set forth. The second part consists of the report of the Ground Water Management Subcommittee, and the third treats federal-state water rights action.
W69-00299

REPORT OF THE COMMITTEE ON WATER RESOURCES.
American Bar Assoc., Chicago Sect of Mineral and Natural Resources Law.

1966 Committee Reports, pp 184-226, 77 ref.

Descriptors: *Water law, *Legislation, *Judicial decisions, Administrative decisions, Minnesota, Illinois, Iowa, Water resources, Federal government, State governments, Water Quality Act, Wild River Act, Water Resources Planning Act.
Identifiers: Water Project Recreation Act, River and Harbor Act.

The report is divided into two parts, the first dealing with legal developments in the field of water resources in various states and the second covering the federal government for the period May 1965 through April 1966. These developments are discussed under the headings of legislation, judicial decisions and administrative action. Although the states reporting are primarily in the western U S, Minnesota, Illinois and Iowa are included. Federal developments in the legislative area include enactment of the Federal Water Project Recreation Act, the Water Resources Planning Act, the Water Quality Act, and the River and Harbor Act. Among matters pending in the 89th Congress are the Wild Rivers Bill and the Colorado River Project. Relevant judicial decisions and administrative action by the Federal Power Commission are set forth.
W69-00300

REPORT OF THE COMMITTEE ON WATER RESOURCES.
American Bar Assoc., Chicago Sect of Mineral and Natural Resources Law.

1967 Committee Reports, pp 200-225, 60 ref.

Descriptors: *Legislation, *Judicial decisions, Georgia, Iowa, Minnesota, Water resources, Federal government, State governments, Administrative decisions.

The report is divided into two parts, the first dealing with legal developments in the field of water resources in various states and the second covering the federal government for the period May 1966 through April 1967. These developments are discussed under the headings of legislation, judicial decisions and administrative action. Although the states reporting are primarily in the western U S, Minnesota, Georgia and Iowa are included. Federal developments in the legislative area includes enactment of several bills pertaining to water quality and water management, e. g., a bill creating a Department of Water Resources and another establishing minimum flows and levels.
W69-00301

PLEASURE BOATING IN A FEDERAL UNION,
Buffalo Univ.
G. Graham Waite.
Buff L Rev, Vol 10, No 2, pp 427-447, Winter 1961. 21 p, 81 ref.

Descriptors: *Boating, New York, Federal-state water rights conflict, *Navigation, Ownership of beds, Admiralty, *Water zoning, Lakes, Inland waterways, Prescriptive rights, Federal government, *Recreation, Public rights, Interstate.

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Identifiers: Commerce power, Private rights.

This article considers the power to authorize recreational boating on inland waterways and to prescribe standards of conduct on water generally, and the power to zone waters to particular uses. Determination of whether to apply federal or state law in this area generally turns on applications of some concept of navigability. Navigability is defined for several purposes: (1) ownership of beds of watercourses in new states, (2) public v private rights, (3) waters subject to federal admiralty jurisdiction, and (4) commerce power application. It is suggested that the admiralty test may be expanded to include waters entirely within one state and which are navigable in fact only by motor driven pleasure craft. The conclusion is that control of activity on inland waters in the first instance is in state hands. However, as the activities take on increasing interstate significance, the federal government acquires power to control the activity as well. As to water zoning, New York's policy is examined. The conclusion here is that local or state zoning for certain uses, such as speed, is not an infringement on Federal law.
W69-00302

PUBLIC V PRIVATE: THE STATUS OF LAKES,
Buffalo Univ.
James Munro.
Buff L Rev, Vol 10, No 2, pp 459-471, Winter 1961. 13 p, 82 ref.

Descriptors: Minnesota, Wisconsin, Michigan, *Recreation, *Access routes, Saw log test, *Navigation, Federal government, Ownership of beds, Shape, Transportation, Prescriptive rights, Boat launching ramps, Fishing, Hunting, Social needs, Lakes.

The article deals principally with the use of lakes by the public for recreation. Specifically, it deals with how this issue has been resolved in Minnesota, Wisconsin, and Michigan, with some comments on how other states have dealt with the issue. The view taken is that navigability has been the controlling concept as to whether the public will have access to a lake. However, it is observed that many states have abandoned this principle in favor of common use irrespective of bed ownership or navigability. The historical dilemma centering on whether a state can define navigability differently than the federal government is examined. The importance given to the use of a lake when statehood was conferred is considered as to the relevance of determining navigability today. The article concludes that access by the public where trespass may occur is today's major problem, but, that in general, the law has kept up with the trend toward increasing common use by the public of lakes for recreation.
W69-00303

APPROPRIATION WATER LAW ELEMENTS IN RIPARIAN DOCTRINE STATES,
Buffalo Univ.
J. H. Beuscher.
Buff L Rev, Vol 10, No 2, pp 448-458, Winter 1961. 11 p, 48 ref.

Descriptors: Wisconsin, Indiana, Ohio, Minnesota, Prescriptive rights, *Natural flow doctrine, *Reasonable use, *Riparian rights, *Prior appropriation, Domestic water, Water pollution, Public utilities, Preferences (Water rights), Land use, Appropriable waters, *Appropriation.
Identifiers: Coriparians, Dam owners.

The article was based on illustrations drawn largely from Minnesota, Wisconsin, Indiana, and Ohio. It set out in detail the basic differences between riparian and appropriation principles, with a short history of the origins of riparianism. The decline of the natural flow precept was analyzed in terms of the reasonable use doctrine. Several specific deviations from pristine riparianism were mentioned including (1) prescriptive rights, (2) rights of domestic use, (3) dam owners and the rights of coriparians, (4) pollution and correlative riparian rights, (5) municipal water utilities and rights of coriparians, (6) preferences to industrial users, and (7) preferences assured by land use zoning. The article concluded that any description of 'riparian water laws' is far more complicated than would appear from repeated quotations about reasonable use, equality of right, and correlative cosharing. The article ignored the problems raised where 'navigability' must be considered.
W69-00305

FEDERAL LIMITATIONS ON STATE WATER LAW,
Buffalo Univ.
Frank J. Trelease.
Buff L Rev, Vol 10, No 2, pp 399-426, Winter 1961. 28 p, 162 ref.

Descriptors: *Federal jurisdiction, *State jurisdiction, Water resources development, *Federal-state water rights conflict, Navigation, Wildlife management, Financing, Planning, Public health, Legislation, Project planning.
Identifiers: Treaty power, War power, Proprietary power, General welfare power.

The most important source of federal jurisdiction over water is in relation to navigable waters under the commerce power. The article relates this power to limitations on the power of a state to legislate, limitations on the applicability of state legislation and the effect on state-granted private rights. Other federal powers in this area are mentioned including proprietary powers, war powers, treaty powers, general welfare powers, and the control of interstate relation. The article emphasizes state and federal coordination and cooperation. Specific reference is made to express federal recognition of state water law, corps of engineers projects, Department of Agriculture programs, federal water resource programs, Dept of Interior acquisiton powers, and federal programs concerned with wildlife management and control. The article concludes that the federal government seems to have almost unlimited jurisdiction over water. Where federal and state interests overlap, cooperation is the general rule. The dominance of the United States is due only in part to its constitutional powers; most of it is due to the dominent position of the federal government as financier and planner. (Crabtree-Fla)
W69-00306

STATE AND FEDERAL WATER LAWS AND CONSIDERATIONS AFFECTING FUTURE LEGISLATION.
North Carolina Board of Conservation and Development, Raleigh.

State and Federal Water Laws and Considerations Affecting Future Legislation, pp 1-151, Jan 1956. 151p.

Descriptors: *North Carolina, *Legislation, Water law, *Federal government, Administrative agencies, State governments, Water policy, Riparian rights, Prior appropriation, Judicial decisions, Eminent domain, Regulation, Federal jurisdiction, Navigation, Water pollution control, Flood control, Planning, Irrigation, Reasonable use.

Section One is devoted to North Carolina water laws. Emphasis is on the actual legislation. The relevant statutes are a major portion of the text. Those statutes which create the administrative agencies in North Carolina are included. In addition, comments are provided by interested persons and agencies. Section 2 gives a state by state synopsis of major water laws. Emphasis is on legislation and administrative regulations. Only North Carolina and Hawaii are not covered. Section 3 is devoted to federal laws pertaining to water resources. The areas included are navigation, flood control, multi-purpose planning, water power, stream pollution, reclamation, irrigation, water conservation and utilization, watershed protection and flood prevention, beach erosion, sea water and artificial rainfall. Section 4 deals with some of the factors to be considered as affecting future water legislation. Heavy emphasis is placed on the prior appropriation doctrine, its advantages and disadvantages. Alternatives to an adoption of the appropriation system are also presented. (Breuel-Fla.)
W69-00308

GEORGIA'S EXISTING WATER LAWS - THE RIPARIAN DOCTRINE.
Georgia Univ., Athens.

In a Study of the Riparian and Prior Appropriation Doctrines of Water Law, pp 1-18, Oct, 1955. 18 p, 23 ref.

Descriptors: Remedies, Civil law, *Judicial decisions, Legal aspects, Legislation, Natural flow doctrine, *Riparian rights, Riparian water, Riparian land, Water law, *Georgia, *Reasonable use, Surface waters, Groundwater, Irrigation, Non-navigable waters, Diversion, Beneficial use, Water pollution, State governments.

A study of the riparian doctrine as it developed in Georgia is presented. Georgia law respecting diffused surface waters, groundwater lakes and ponds, and non-navigable streams is given in concise form. Whether or not a riparian proprietor may put water to a specific use depends on whether or not the use is reasonable. There is no clear criterian, since reasonableness is a jury question. There is a distinction between diversion and detention of water. In the case of the former, a lower riparian owner may collect damages whether or not he is actually injured. Injunction and damages are both proper remedies. In the case of the latter, the reasonableness of the use is the key to whether or not a lower riparian owner has a remedy. Specific cases involving the application of the riparian doctrine in Georgia are considered and summarized. (Pfeiffer-Fla.)
W69-00313

FEDERAL JURISDICTION OVER WATER IN THE EASTERN UNITED STATES,
Michigan State Univ., East Lansing.
F. J. Trelease.
In Water Rights Conference, pp 1-18, March 29, 1960. 18 p, 19 ref.

Descriptors: *Federal jurisdiction, *State jurisdiction, Federal government, State government, *Federal-state water rights conflicts, Water law, Legal aspects, Administrative agencies, Legislation.

The article considers federal jurisdiction over water in relation to state jurisdiction in the field. The sources from which the federal government derives its power are considered, as are the sources of state power, and an analysis is drawn in areas where the two might conflict. The author then considers federal programs and how they are set up to work with the states. He enumerates the areas in which the two governments coordinate and cooperate in their actions. The cooperative and coordinative procedures have been concessions to State and local interests, thus permitting an interplay of governments and the balancing of state and national interests. The procedures of the federal agencies that have water resource development programs are designed to give the states a voice in those programs. (Horner-Fla.)
W69-00314

DEVELOPMENT AND ELEMENTS OF THE RIPARIAN DOCTRINE WITH REFERENCE TO THE EASTERN STATES,
Michigan State Univ., East Lansing.
H. H. Ellis.
In Water Rights Conference, pp 19-34, Mar 29, 1960. 16 p, 22 ref.

Descriptors: *Riparian rights, *Riparian land, Watercourses (Legal), *Water law, Legal aspects,

Streams, *Natural flow doctrine, Reasonable use, Water utilization.

The author first considers the history of the riparian doctrine. He sets forth the conditions preceeding it and explains its spread. The article then considers the principal elements of the doctrine that have developed over the years. It considers natural and artificial uses, the natural flow doctrine and the reasonable use doctrine. The discussion concerns mainly non-navigable watercourses, but it is pointed out that the doctrine usually applies to navigable watercourses also. Secondly, the author traces legislative developments in the area and considers their effect on water control.
W69-00315

IOWA'S NEW WATER LAW,
Michigan State Univ., East Lansing.
J. O'Connel.
In Water Rights Conference, pp 54-67, Mar 29, 1960. 14 p, 3 ref.

Descriptors: *Iowa, *Watercourses (Legal), *Drainage, Water utilization, State governments, *Legislation, Permits, Water law, Legal aspects.

The article discusses Iowa Code Chapter 455A (1958). The law provides for the establishment of a permit system and a Water Commissioner to administer the system. The law prohibits the diversion, storage or withdrawal of water for regulated uses from any natural watercourse, underground basin or watercourse, drainage ditch or settling basin without a permit from the water commissioner. In addition, no water or material from the surface may be diverted into any underground watercourse or basin without a permit. The statute enumerates the uses of water which are unregulated and therefore require no permit. The author also discusses the work of the Pendleton Committee, which made a comprehensive study and drafted the legislation.
W69-00316

WATER RIGHTS,
Wisc. Univ. School of Law.
J. H. Beuscher.
College Printing and Typing Co., Madison, Wisc., 1967, pp 1-434, 434 p, 5 map, 3 illus, 35 photo, 4 dwg, 2 tab, 5 chart.

Descriptors: *Water rights, *Water law, *Riparian rights, *Judicial decisions, Wisconsin, Southeast U.S., Interstate compacts, Prior appropriation, Northeast U.S., Water policy, Pollution abatement, Hydrologic cycle, Surface runoff, Groundwater, Watercourses (Legal aspects), Water allocation (Policy).
Identifiers: Public interests.

This work presents materials used for a course in water law at the University of Wisconsin Law School. The focus of the study is on the law of the eastern states and on the law of Wisconsin in particular, although western appropriation law and western water allocating institutions are also surveyed. Included along with cases are excerpts from law reviews, statutes, compacts, Restatements, and other material. Cases are often supplemented by extensive editorial comments. The major areas included in the study are: (1) water regimes and water law, including a brief study of the hydrologic cycle; (2) the law of diffused surface water; (3) the law of percolating ground water; (4) private rights in watercourses under both the riparian and prior appropriation systems; (5) limitations imposed on private water rights by assertions of public interest; (6) water pollution abatement; and (7) allocations of water between states and interstate water compacts.
W69-00317

TAXATION OF LANDS COVERED BY NAVIGABLE WATERS USED FOR COMMERCIAL PURPOSES.
State of Florida.

1964 Fla Att'y Gen Rep, No 064-65, May 19, 1964. 2 p.

Descriptors: *Florida, *Taxes, Beds, Navigable water, Riparian land.

The question is whether privately owned lands covered by navigable waters are subject to ad valorem taxation when used by their owners, or under their authority, for commercial purposes. The opinion stated that lands in private ownership are subject to taxation, unless specifically exempted by some provision of the State Constitution, or are held and used exclusively for religious, scientific, municipal, education, literary or charitable purposes. The land in question is taxable unless it falls within some constitutional or valid statutory tax exemption. (Horner-Fla)
W69-00319

REGULATION OF COASTAL CONSTRUCTION.
State of Florida, Office Attorney General, Tallahassee.

Rep Att'y Gen Fla 065-119, Oct 25, 1965.

Descriptors: *High water mark, Low water mark, *Local governments, Riparian land, Public rights, State jurisdiction, *Florida, *Intertidal areas, Remedies, Structures, Statutes, Ordinances, Coasts, Riparian rights.
Identifiers: Purprestures, Setback lines.

The sovereign state, in the public interest, may subject a landowner's riparian rights to lawful regulation. Florida, by statute, requires its Board of Conservation to issue permits for any coastal construction undertaken by a person, firm, corporation etc, upon the sovereignty lands of the state below the mean high water line of any of its tidal waters. The conservation board is similarly empowered by statute to compel the removal of any structure upon such land if it deems it unnecessary, undesirable, serves no public purpose or is dangerous to human life, health or welfare. There is, however, no specific statutory authority by which the Board can regulate coastal construction above the mean high water line on privately owned property, even if such construction would have an adverse effect on public interests. A board of county commissioners likewise has no specific statutory authority to create setback lines on the foreshore of incorporated areas, although such a board may, with the consent of the conservation board and any municipality or other involves political authority, regulate physical work and activities along the county-shoreline. (Geraghty-Fla)
W69-00320

WATER AND SEWER REGULATIONS.
State of Florida, Tallahassee.

Fla Stat Ch 367 (1967).

Descriptors: Water works, Water distribution, Sewage districts, Water law, *Public utilities, *Use rates, Water transfer, *Florida, Administrative agencies.

Section 367.02 defines 'water system,' 'sewer system,' and 'public utility.' Section 367.03-.06 provide for the registration and certification of public utilities. Section 367.07 delineates the powers of the Florida Public Services Commission and section 367.01 establishes its jurisdiction. Section 367.08 sets up the limits to which a system may expand and provides procedures for accomplishing such. Section 367.10 provides for the transfer of certificates. Section 367.11 sets forth the duties of a public utility and Sections 367.12 through .16 deal with rates. Section 367.15 further delineates the powers of the commission and section 367.21 provides that its jurisdiction shall be exclusive. (Dann-Fla)
W69-00321

STATE BOARD OF CONSERVATION - WATER RESOURCES DIVISION.
State of Florida, Tallahassee.

Fla Stat Ch 373 (1967).

Descriptors: *Artesian wells, Well regulation, Public benefits, Beneficial use, Average flow, *Administration, Resources development, Water law, Water districts, Weather modification, Storage, Reasonable use, Easements, Adjudication procedure, *Saline water-freshwater interfaces, River basins, *Florida, Administrative agencies, Legislation.

Section 373.021 defines artesian wells and waste. Section 373.031 provides that the flow of artesian wells must be regulated within 90 days after June 15, 1953. Section 373.041 provides that violation of .021 or .031 shall be a misdemeanor. Section 373.051 provides for the capping of unregulated wells by the state and assessment of costs against land owner. Section 373.061 exempts from 373.021-.051 those wells which feed lakes in existence prior to June 15, 1953 where the flow is necessary to the existence of the lake. Section 373.072 (1) declares waters to be a natural resources, (2) vests control in the state and declares policy. Section 373.081 defines various terms for statutory purposes. Section 373.131 sets forth general powers and duties of the Water Resources Division. Section 373.141 authorizes capture, storage and use of water under certain circumstances. Sections 373.141-.182 empower the State Board of Conservation to set up water regulatory districts and provide the administration of same. Section 373.192 provides for annual conferences of water resources development programs. Section 373.193 provides for a representative to the southeast river basins resources advisory board. Sections 373.194-.221 deal with establishing a salt water barrier line. Section 373.321 vests power in the division of water resources to operate within any flood control or water management district. (Dann-Fla)
W69-00322

PLANNING FOR STATE WATER RESOURCES ADMINISTRATION,
Dwight F. Metzler.
AWWA J Vol 58, No 7, pp 793-800, Jul 1966. 8 p, 11 ref.

Descriptors: Administrative agencies, *Coordination, Decision making, *Future planning (Projected), Kansas, Long term planning, Programs, *Resource allocation, State government, Water resources, Administration, *Planning, Water allocation (Policy).

It has become increasingly important for each state to organize a central program for the allocation, distribution, and quality control of water resources. In order to implement such a program, the state must determine its water needs in sufficient detail to provide guidance to policy objectives. The economic and social water needs of a state may differ substantially from federal needs. Basic economic and population data provides a basis for the allocation of water among several alternative purposes. The state should implement its policy through coordination with agencies of local and federal government. The state should provide tax laws and laws governing the issuance of bonds so that the local governments can deal with their water supply. A legal framework in which one agency is responsible for keeping the legal aspects of the program under continuous study is necessary for the implementation of policies. The responsibility for the development of policy and the coordination of the state agencies which collect data, investigate, and enforce laws, should be focused on

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one agency. Kansas has made marked progress using this technique. (Molica-Fla)
W69-00327

POLLUTION CONTROL AND THE FEDERAL POWER COMMISSION,
J. A. Carver.
Natural Resources Lawyer, Vol 1, No 1, p 32-38, Jan 1967. 7 p, 6 ref.

Descriptors: *Air pollution, *Water pollution, *Political aspects, Federal Power Act, Federal government, *Administrative agencies.
Identifiers: Federal Power Commission.

The author considers the responsiveness of the FPC to the problems of air and water pollution that might come within its boundaries. He points out the fields in which the FPC might act in combatting air and water pollution. The general public has a definite interest in the responsiveness of the FPC to pollution problems. The article points out the right of the public to participate in agency decisions and the need for interested citizens to take an interest. Recent court decisions have indicated that the agency must consider all factors brought before it in determining what is the best course of action in light of the public interest. The people have a right to be heard by the commission and it must consider the factors that they might bring before it. (Horner-Fla)
W69-00329

THE LEGISLATIVE APPROACH TO AIR AND WATER QUALITY,
M. N. Edwards.
Natural Resources Lawyer, Vol 1, No 1, pp 58-69, Jan 1968. 12 p, 16 ref.

Descriptors: *Water quality, *Water Quality Act, Air pollution, Water pollution, Planning, Clean Air Act, Federal government, Administrative agencies, State government, Local government, Legislation, Water pollution control, Pollution abatement.
Identifiers: Clean Water Restoration Act, Water Pollution Control Act, Water Pollution Control Admin.

The article covers the basic federal legislation dealing with water and air pollution. The federal legislation has placed the primary responsibility for the control and abatement of air pollution on State and local governments. Congress has assumed a role of support and leadership by providing machinery and money; but state and local governments in many instances have not responded as adequately as the problem demands. Congress has provided strong and effective tools for the control of water pollution, but the problems are increasing and both local and federal governments must increase efforts in order to keep pace. (Horner-Fla)
W69-00330

GEORGIA LAWS, POLICIES AND PROGRAMS PERTAINING TO WATER AND RELATED LAND RESOURCES,
Georgia Institute of Technology, Water Resources Center.
G. R. Elmore.
Final report Project B-2701, Contract DA-CW55-67-C-001, Water Resources Center, Ga. Inst. of Tech., Atlanta, Ga., June 1967, 123 p, 51 ref.

Descriptors: *Georgia, *Legislation, *Judicial decisions, *Water law, Planning, Project planning, State government, Water rights, Water policy, Water quality, Administrative agencies, Local government, Water districts, Drainage, Conservation, Water utilization, Financing.

The background and current status of the legislative and organizational framework for the administration of Georgia's water resources are described in the report. Important water- and related land-resource developments are inventoried and a bibliography of important references and data sources is appended. Information on laws includes pertinent parts of the State constitution, statutes, regulatory measures, and case law as defined by significant court decisions. The administrative structure is outlined in terms of organic laws and administrative actions concerned with powers, duties, procedures and programs. Agencies and organizations covered include State, interstate, special district, and local entities concerned significantly with the management of Georgia's water resources. Agency programs are described, with emphasis on research, data collection, planning, construction, regulation, drainage, irrigation erosion and sedimentation control, and preservation of reservoir sites. (Horner-Fla.)
W69-00331

RHODE ISLAND WATER PLANNING,
J. H. Chafee.
J Amer Water Works Ass'n, Vol 59, No 4, pp 1213-1216, Oct 1967. 4 p.

Descriptors: *Rhode Island, River systems, Planning, Project planning, Reservoirs, Legislation, State government, Political aspects, Water storage, Water supply, Future planning (Projected).
Identifiers: Regional approach (Planning).

In an address to the Annual Conference of the American Water Works Commission, Governor John Chafee of Rhode Island explained the Rhode Island state-wide approach to water planning. In 1960 a study was prepared by expert consultants which showed three large areas that should be acquired for future reservoirs. Due to political problems only two of the areas had been acquired by 1964 and the third area was not purchased until a drought in 1966 increased the public's awareness of the water shortage problem. A task force was set up to make proposals to the legislature. As a result of the report of the task force, a state-wide water resources board was established to coordinate water projects and to work on long-range water planning. (Horner-Fla)
W69-00332

LEGAL DECISIONS INVOLVING WATER AND WASTEWATER,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00334

NOR ANY DROP TO DRINK: PUBLIC REGULATION OF WATER QUALITY PART I: STATE POLLUTION CONTROL PROGRAMS,
U of Iowa College of Law, Iowa City, Iowa.
N. William Hines.
U of Iowa L Rev, Vol 52, No 2, pp 186-235, Oct 1966. 51 p, 259 ref.

Descriptors: *Water pollution, Non-consumptive use, Consumptive uses, *Municipal wastes, *Industrial wastes, Agricultural chemicals, State governments, *Water law, Judicial decisions, Water pollution control, Water quality control, Public health, Legislation, Pollutants, Water demand, Pollution abatement, Administrative agencies, Organic wastes.

The primary purpose of this first of three articles is to explore state pollution control programs. As a background for this study, the author discusses the scope of the water pollution problem on terms of the demand for water and water quality. In short, a sufficient quantity of water is not the only problem. There is a qualitative problem as well, based on a hierarchy of water demands. The author briefly discusses the major pollution sources: municipal sewerage, industrial waste and agricultural waste. Consideration is also given to the nature of the conflict between private and public interest. The final phase of the background for state regulation is a discussion of the judicial remedies. The author then introduces state regulatory programs. In addition, a section is devoted to the role of public opinion. Following is a study of the constitutional problems inherent in state control and the limits on the police power. The final segment is devoted to the state's control, including patterns of agencies, the scope of the regulatory power, the creation of standards and their enforcement, and the importance of planning. (Breuel-Fla)
W69-00335

WATER POLLUTION - ATTEMPTS TO DECONTAMINATE FLORIDA LAW,
U of Florida, Gainesville, Florida.
Frank E. Maloney, Sheldon J. Plager, and Fletcher N. Baldwin.
U Fla L Rev, Vol 20, No 2, pp 131-157, Fall 1967. 26 p, 174 ref.

Descriptors: *Water pollution, Nuisance (Water law), *Pollution abatement, Reasonable use, Standards, *Water quality act, Water quality control, Water pollution treatment, Domestic wastes, Agricultural chemicals, Industrial wastes, Phosphates, *Legislation, Legal aspects, Federal government, Regulation, Rivers and Harbors Act, Florida, Remedies.
Identifiers: 1967 Fla. Air and Water Pollution Control Act, 1965 Model Pollution Control Act, Federal Pollution Control Act.

Pollution in Florida arises from domestic, industrial and agricultural uses. Reasonable-use rule in Fla. imposes liability on pollution which is an unreasonable interference with use of water. Pollution may be attacked on nuisance or trespass theory. Injunction is preferable remedy; balance of convenience doctrine may defeat it. Damages may be given, but are inadequate without injunction because pollution is only compensated for, not prevented. Before 1967 Bd. of Health administered Pollution of Waters Act, approved sewage treatment plants, conducted research and gave technical aid to cities and industries. Local pollution control was under County Water and Sewer, Waste From Mines, and Municipal Zoning Acts. 1967 Florida Air and Water Pollution Control Act transferred regulatory powers of Bd. of Health to special agency, provided for permit system, and imposed state standards on local programs. 1967 Florida Act is compared with 1965 model act. 1967 act has stronger penalities; both have injunctive relief and civil damages. Federal Pollution Control Act of 1965 provides for abatement proceedings, but will normally not displace state actions. Plan requires states to establish guide lines, and authorizes funds for construction of sewage treatment plants and federal research grants. (Ausness-Fla)
W69-00336

DIFFUSED SURFACE WATER: SCOURGE OR BOUNTY,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00337

IOWA'S NEW WATER STATUTE - THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER,
Jeffrey O'Connell.
Iowa L Rev, Vol 47, No 3, pp 549-636, Spring 1962. 88 p, 528 ref.

Descriptors: *Iowa, *Legislation, Judicial decisions, Legal aspects, Riparian land, Riparian rights, Riparian waters, Usufructuary right, Water law, *Water permits, Water rights, Watercourses (Legal), State governments, Hydrologic cycle, Navigable waters, Artificial use, Federal government.
Identifiers: *Constitutional law, Police power.

The thesis of the article is that provisions of Iowa's water rights statute, Iowa Code chapter 455A (1958), regulating existing uses of water (assuming they are regulated) should not render it unconstitutional. The author supports this thesis by a detailed examination of the background of the statute, its terms, prior laws, the need for new legislation, and

the legal issues the statute brings forth. The riparian right as a vested right is analyzed, as vested rights are generally protected from legislative deprivation. It is arguable that the statute does not affect vested riparian rights. The treatment given water rights legislation by state and federal courts is set forth, particular attention being given to the Iowa Supreme Court and its view of the police power. The distinction between existing and unused rights to water may serve to uphold the constitutionality of the statute. After summarizing the nature of common-law rights to water, including the powers of the state and federal government over water, the reciprocal rights of others, and the right to capture water, changes brought about by the Iowa statute are examined. (Patterson-Fla)
W69-00338

COMPENSABLE VALUES IN FEDERAL 'TALKING' OF DAMSITES.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00339

6F. Nonstructural Alternatives

FLOOD CONTROL ALTERNATIVES 'AND THE ECONOMICS OF FLOOD PROTECTION,
Washington Univ, Seattle.
Robert C. Lind.
Water Resources Research, Vol 3, No 2, pp 345-357, Second Quarter 1967. 13 p, 16 ref.

Descriptors: Flood control, Flood damage, *Flood plain insurance, *Flood plain zoning, Flood proofing, *Flood protection, *Risks, Benefits, Profit.
Identifiers: *Safety loading charge, Structural protection, Land enhancement, *Expected value of losses, Transaction costs.

This paper discusses and compares the economic effects of alternative programs for coping with flood losses. Special emphasis is placed on the use of flood insurance. The measurement of land-enhancement benefits is discussed in some detail. Several major conclusions were drawn. First, it is clear that from an economic point of view flood zoning is not a desirable method of coping with flood losses. It can only be justified on the grounds of political or administrative feasibility, which other programs might lack. Second, flood insurance should be carefully considered as an integral part of any program for coping with flood losses. Finally, land-enhancement benefits, properly measured, represent real gains that should be incorporated in benefit estimates. (Seneca-Rutgers)
W69-00229

6G. Ecologic Impact of Water Development

PETERSON V UNITED STATES (ACCRETION).

384 F 2d 664-668 (8th Cir 1967)

Descriptors: *Accretion (Legal aspects), *Boundaries (Property), Riparian land, Legal aspects, Riparian rights, Banks, Navigable waters, Island, Missouri River, Dams, Reservoirs, North Dakota.
Identifiers: Water line.

Action was brought to determine ownership of land condemned by the U. S. for construction of dam and reservoir. The disputed land once consisted of islands in the Missouri River. The islands disappeared and the land in question formed as accretion to the east bank of the river. The North Dakota statute provided that accretion to the bank of a river or stream, navigable, belongs to the owner of the bank. Where the water line is the boundary of property, that line, no matter how it shifts, remains the boundary. The accretion attached itself to the mainland and became the property of owners of the land banks to which it accreted. (Rives-Fla)
W69-00028

STEPHENS V DRAKE (OWNERSHIP OF LAND CREATED BY RIVER CHANGING COURSE).

134 So 2d 674-679 (La 1961).

Descriptors: Louisiana, Judicial decisions, *Accretion (Legal aspects), Ownership of beds, Wild rivers, River beds, *River flow, *Alluvial channels, Channels, Channel flow, Sand bar, Relative rights, Alluvion.
Identifiers: *Red River, Peninsula.

This action is the result of a dispute as to possession and ownership of land as a consequence of the Red River changing its course. It was held that the owners of land along the east bank of the river as it flowed prior to changing its course did not lose title to a peninsula consisting of alluvion and attached sandbar which had extended into the river from the east bank as the river formerly flowed, by reason of the peninsula's separation from their property when the river changed to a more easterly course, and the owners gained title to the old river bed as well, where the new channel cut through their land. (Crabtree-Fla)
W69-00030

ARIDITY AND SEMI-ARIDITY, A PHYTO-CLIMATIC CONSIDERATION WITH REFERENCE TO INDIA,
Institut Francais, Pondichery, India.
V. M. Meher-Homji.
Ann of Arid Zone, Vol 4, No 2, pp 152-158, Sept 1965. 7p.

Descriptors: *Arid climates, Semiarid climates, *Ecology, Humidity, Temperature, Precipitation (Atmospheric), Vegetation, Evaporation, *Classification, Climatic data, Agronomy, *Geographical regions.
Identifiers: India, *Aridity.

Bases for classification of arid or semi-arid regions were reviewed. An index of aridity-humidity was proposed based on the ecological formulae of Gaussen. Three principal ecological factors, temperature, precipitation and dry periods were considered. Vegetation types were explained on the basis of this index and areas of India were classified according to the developed index. (Affleck-Ariz)
W69-00369

07. RESOURCES DATA

7A. Network Design

NEW ASPECTS OF RIVER RUNOFF CALCULATIONS,
Pub for U. S. Department of Commerce and National Science Foundation, Washington, D. C., by Israel Prog for Scientific Transl, Jerusalem.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00084

USE OF ATMOMETERS IN ESTIMATING EVAPOTRANSPIRATION,
California State Department of Water Resources, Sacramento.
For primary bibliographic entry see Field 02D.
For abstract, see .
W69-00105

OPTIMIZING SAMPLING INTERVALS,
Daniel, Mann, Johnson, and Mendenhall, DAMOC/WHO, Istanbul, Turkey.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-00340

7B. Data Acquisition

DILUTION METHODS OF MEASURING TRANSPORT OF SAND FROM A POINT SOURCE,
Hydraulics Research Station, Wallingford, Berkshire, England.
For primary bibliographic entry see Field 02J.
For abstract, see .
W69-00145

IN SITU MEASUREMENT OF SOIL SALINITY WITH A SENSOR,
U. S. Salinity Lab., Riverside, Calif.
For primary bibliographic entry see Field 02G.
For abstract, see .
W69-00163

FORECASTING THE LEVELS OF THE GREAT LAKES,
U. S. Lake Survey, Detroit, Michigan.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-00202

RADIOMETRIC STUDIES OF THE FLORIDAN AQUIFER,
Florida State Univ., Tallahassee, Florida.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00212

ON THE OPTIMUM RECORDING OF A TYPE OF HYDROLOGICAL DATA,
Delft Technological Univ, The Netherlands.
M. B. Abbott, E. Pardo Castro, and P. Tas.
Bull Int Ass Sci Hydrol, Vol 12, No 1, pp 44-58, Mar 1967. 15 p, 14 fig, 6 ref.

Descriptors: *Hydrologic data, Mathematical models, *Optimization, *Sampling, *Timing, Frequency analysis, Computer programs, Approximation method, Time of concentration, Scheduling, Hydrologic properties, Analytical techniques.
Identifiers: Convergence, Difference equations.

An algorithm was developed for finding the optimum spacing of hydrologic data collection, where short periods of intense measurement activity may often be followed by relatively long quiescent periods. The algorithm provided a translation program which resulted in considerable reductions in data collection. It was shown that if the data stream could be represented by a twice differentiable function, that for a particular norm, the second moment of the second derivatives were constant over all optimum collection intervals. That property was used to construct an iterative difference scheme. Conditions for stability of the scheme were determined and incorporated into a computer program. The program was tested on a variety of data with satisfactory results. A flow diagram of the computer program was shown. Further development of the method was suggested. (Gysi-Cornell)
W69-00347

7C. Evaluation, Processing AND Publication

THE QUALITY OF WATERS PERCOLATING THROUGH STRATIFIED SUBSTRATA, AS PREDICTED BY COMPUTER ANALYSES,
California Univ., Water Resources Center, Davis.
For primary bibliographic entry see Field 02G.
For abstract, see .
W69-00164

COMPUTER SYSTEM FOR THE REDUCTION AND ANALYSIS OF SOIL MOISTURE DATA,
Virginia Polytechnic Institute, Blacksburg.
V. O. Shanholtz.
OWRR report from Virginia Water Resource Research Center, 1968.

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Descriptors: Data processing, *Computer programs, Soil moisture, Moisture content, *Moisture availability.

A system of computer programs, written in Fortran IV for the IBM 7040-1401 system, but readily convertible to other systems, was designed specifically to expedite the reduction and analysis of soil moisture data. The system contains three unique or independent programs for the (1) reduction of basic field data, (2) coding, summary, and plotting, and (3) statistical analysis. Total or available soil moisture for depths of 3 to 6 inch increments up to a maximum of 72 inches can be determined for individual plots or any combination of plots for a given experimental design. The data can be plotted for any combination and/or coded for subsequent statistical analyses. (Shanholtz-VaTech)
W69-00232

LOW-FLOW INVESTIGATIONS: TECHNIQUES OF WATER-RESOURCES INVESTIGATIONS,
U S Geological Survey.
H. C. Riggs.
U S Geol Surv Prelim Rep, 15 p, 1968. 14 fig, 3 tab, 8 ref.

Descriptors: *Low flow, *Discharge (Water), Hydrographs, Stream gages, Duration curves, Frequency analysis.
Identifiers: Low-flow investigations, Low-flow frequency.

Procedures for defining and evaluating low-flow frequency curves at gaging stations, methods of estimating low-flow characteristics at sites where little discharge information is available, and methods for designing data-collecting systems and reporting results are described. Low-flow characteristics at a gaging station may be described by frequency curves of annual or seasonal minimum flows, by duration curves, and by base-flow recession curves. Ordinarily the characteristics defined at gaging stations cannot be transferred to ungaged sites because low flows are highly dependent on basin geology and evapotranspiration, neither of which can be adequately described, at present, by indexes in a given basin. However, estimates of low-flow characteristics at an ungaged site may be made if a few discharge measurements of base flow during the low-flow season are available. (Knapp-USGS)
W69-00245

COMPUTER SYSTEM FOR REDUCTION AND ANALYSIS OF HYDROLOGIC DATA,
Department of Agriculture, Beltsville, Md., Agricultural Research Service, Virginia Polytechnic Inst., Blacksburg, Virginia.
V. O. Shanholtz, and J. B. Burford.
Agricultural Research Service Bull ARS 41-132, July 1967, 90 pp, 9 fig, 29 tab, 4 ref, 10 append.

Descriptors: *Data processing, *Data storage and retrieval, Computer models, *Computer programs, Rainfall, Runoff, Streamflow, Land use, Soil moisture.

A system of computer programs has been developed to handle data related to precipitation, streamflow, temperature, air movement, soil moisture, and land use. Programs are designed to achieve the routine processing, to make certain analyses and summaries, and to select and arrange data in the required format for direct listing on the standard forms, which have been developed for the U.S. Dept. of Agric. Miscellaneous Publication, 'Hydrologic Data for Experimental Watersheds in the United States,' which is a continuing series. The programs are written in Fortran IV for use on the IBM 7040-1401 computer and are designed to accept input information in data card or magnetic tape form with the output on magnetic tape. (Shanholtz-Va Tech)
W69-00323

08. ENGINEERING WORKS

8A. Structures

A WATER RESOURCE MODEL,
Stanford Univ, Palo Alto, California.
For primary bibliographic entry see Field 06A.
For abstract, see .
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QUEUEING THEORY AND RESERVOIR DESIGN,
Harvard Univ, Cambridge, Mass.
For primary bibliographic entry see Field 06A.
For abstract, see .
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A MODEL FOR DESIGNING WATER DISTRIBUTION PIPE NETWORKS,
Harvard Univ, Cambridge, Mass.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00358

TECHNIQUES FOR FINDING RESERVOIR OPERATING RULES,
Harvard Univ, Cambridge, Mass.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00359

8B. Hydraulics

ESTABLISHED SURGE ON AN IMPERVIOUS VEGETATED BED,
Div of Agr Eng Services, Agr Tech Services, Republic of S Africa, and California Univ., Davis.
W. P. J Wessels, and Theodore Strelkoff.
ASCE Proc, J Irrig and Drainage Div, Vol 94, No IR1, Pap 5832, pp 1-22, Mar 1968. 22 p, 1 tab, 10 fig, 15 ref.

Descriptors: *Open channel flow, *Steady flow, *Surges, *Irrigation ditches, *Model studies, Mathematical models, Hydraulics, Water measurement.
Identifiers: *Vegetated bed, Impervious bed, Parallel wire depth gages.

Theoretical and experimental determinations are made of the steady flow of a surge of water onto a dry, impervious bed studded with artificial vegetation-wires protruding through the flow at densities of 7.5, 29 and 116 wires per sq ft. The pertinent differential equation of the flow profile implies movement on a broad front, hydrostatic pressure distribution, no interference between the wakes of the individual resistance elements and constant bottom shear between the elements. Experimental data on profile shape and tip speed are gathered and recorded electrically by a combination of parallel-wire resistance probes, a scanner, an a. c. resistance bridge, and Sanborne recorder. Comparison of these data, brought to nondimensional form, with an analytic solution of the differential equation in similar form shows good agreement when the measured tip velocity has decreased from its initial value to within 5% of its terminal value, the flow velocity at normal depth. (Knapp-USGS)
W69-00088

PHYSICAL PRINCIPLES OF WATER PERCOLATION AND SEEPAGE,
Technion-Israel Institute of Technology, Haifa, Faculty of Civil Engineering.
J. Bear, D. Zaslavsky, and S. Irmay.
UNESCO Arid Zone Research, Series No 29, 465 p, 1968. 14 tab, 291 fig, 546 ref.

Descriptors: *Hydrology, *Hydraulics, *Porous media, *Percolating water, Unsaturated flow, Saturated flow, Leakage, Seepage, Filtration, Hydrodynamics, Models.
Identifiers: *Flow in porous media, *Hydrodynamic dispersion, Textbook.

A comprehensive reference and textbook that considers saturated and unsaturated flow of water, immiscible fluids, and miscible fluids through soil, rock and other porous media. Unsaturated flow, which is extremely complex because of interactions between water, air, dissolved and immiscible contents of water, the various constituents of porous media, and various interfacial tensions, is the central topic covered. Basic equations and assumptions of hydrodynamics are reviewed. Because the subject inevitably involves the fields of oil exploration, coastal fresh water development, pollution control, well performance, industrial filtration, chemical and petroleum engineering, ceramics, metallurgy, aeronautical engineering, drying and wetting of materials, and many other hydraulic and hydrologic studies, many fundamentals of fluid movement are covered in detail and illustrated with appropriate figures and equations. Because the book is intended for engineers who have to solve hydrologic and hydraulic problems, heavy emphasis is given to successful mathematical, empirical, and other methods for dealing with field situations. (Knapp-USGS)
W69-00135

8D. Soil Mechanics

SEEPAGE THROUGH DAMS IN THE COMPLEX POTENTIAL PLANE,
Utah State Univ, Water Research Lab, Logan.
Roland W. Jeppson.
ASCE Proc, J Irrig and Drainage Div, Vol 94, IR1, Pap 5835, pp 23-39, Mar 1968. 17 p, 2 tab, 5 fig, 15 ref.

Descriptors: *Seepage, *Earth dams, *Boundaries (Surfaces), Anisotropy, Isotropy, Porosity, Dupuit-Forscheimer theory, Darcys law, Digital computers, Approximation method, Fluid mechanics, Seepage.
Identifiers: *Finite difference method.

A method is described of direct procedure for obtaining the solution of seepage through a homogeneous isotropic or anisotropic earth dam. Solution is obtained by finite differences. The x and y coordinates are considered the dependent variables and the velocity potential and the stream function the independent variables. Boundary value problems for y and x are formulated in the complex potential plane. Since the size of the flow field in the complex potential plane is unknown from specification of the size and shape of the dam, the final solution is obtained from a cycle of solutions each subsequent one of which is obtained in a field of more nearly correct size. Comparisons are given between the coordinates on the phreatic line obtained by this finite difference method and those obtainable from a solution by the velocity hodograph. Summarizing the results from a number of solutions of different geometries, a graphical relation is given relating the geometric parameters of the dam and the seepage quantity. (Knapp-USGS)
W69-00086

DELAWARE COAST, BEACH EROSION CONTROL AND HURRICANE PROTECTION.
Army Corps of Engineers, Washington, D. C.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-00114

09. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, AND Research Act Allotments

COMPILATION OF WATER RESOURCES RESEARCH IN SOUTH CAROLINA.
South Carolina Water Resources Advisory Committee.

Water Resources Res Inst, Clemson Univ, 38 p, May 1968.

Descriptors: *Data collections, *Research and development, *South Carolina, *Water Resources Research Act, Water resources, Hydrology, Engineering, Planning, Management.
Identifiers: Clemson University.

A report on water resources research in South Carolina was prepared by the South Carolina Water Resources Advisory Committee. One of the functions of this committee is to appraise the current level of research activity and to make recommendations on new research that should be initiated. The original manuscript prepared and distributed in 1966 is revised in an effort toward that objective. All Federal and State agencies concerned with water resources were requested to submit a description of the research projects currently being conducted in the State by their agency. A compilation of the project descriptions was submitted. The projects selected for inclusion in the report cover many aspects of the water resources field. However, water-related investigations where the primary objective was directed to plant growth, fish reproduction, etc are not included. The selection was made and categorized according to information by the Federal Council for Science and Technology Committee on Water Resources Research published in 'A Ten-Year Program of Federal Water Resources Research' in February 1966. (Knapp-USGS)
W69-00255

INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA.
Water Resources Research Institute, North Carolina Univ.

North Carolina Univ Water Resources Res Inst Rep 4, 76 p, July 1, 1968.

Descriptors: *Data collections, *Research and development, *North Carolina, *Water Resources Research Act, Water resources, Hydrology, Engineering, Planning, Management, Fish, Forests, Recreation.
Identifiers: North Carolina University.

An inventory of research projects is updated and reissued annually. All known research projects in North Carolina, including private industry, State and Federal agencies, as well as the senior colleges and universities are listed. Sources of funding, which not shown individually for university research projects, include the Office of Water Resources Research, Federal Water Pollution Control Administration, National Science Foundation, N C Dept of Water and Air Resources, the universities involved, many other agencies, and private industry. The distribution of the research projects by industry, agency, or institution is shown. A total of 267 projects are included. These range in size from major grant or contract work down to graduate thesis research projects with very low levels of financial support. (Knapp-USGS)
W69-00256

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UNITED STATES DEPARTMENT OF THE INTERIOR
STEWART L. UDALL, Secretary

OFFICE OF WATER RESOURCES RESEARCH
Roland R. Renne, Director

WATER RESOURCES SCIENTIFIC INFORMATION CENTER
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FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

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To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
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THERMODYNAMIC RELATIONSHIPS WITHIN THE SYSTEM: SEDIMENTS-SEA-AIR,
Massachusetts Univ, Amherst.
For primary bibliographic entry see Field 02K.
For abstract, see .
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02. WATER CYCLE

2A. General

A MOISTURE-BALANCE PROFILE ON THE SIERRA NEVADA,
Nevada University, Reno, Desert Res. Inst.
For primary bibliographic entry see Field 02B.
For abstract, see .
W69-00461

GLOSSARY OF SELECTED HYDROLOGIC TERMS,
Wyoming Univ., Laramie.
Paul A. Rechard, and Richard McQuisten.
Water Resour Res Inst, Univ Wyoming, May 1966. 42 p, 1 tab. OWRR Project A-999-Wyo.

Descriptors: *Hydrology, *Dictionaries, Water resources.

This glossary of terms was prepared so that all persons involved in the project of Water Resource Operations Study would have a common source for the definition of terms frequently used in hydrology.
W69-00666

2B. Precipitation

MEASUREMENT OF PRECIPITATION OVER LAKE MICHIGAN,
Illinois State Water Survey, Urbana.
Stanley A. Changnon, Jr., and Floyd A. Huff.
OWRR Project A-012-Ill, Reprint Ser 65, pp 235-248, 1966. 14 p, 3 fig, 4 tab, 20 ref.

Descriptors: Bibliographies, *Atmospheric precipitation, *Measurement, *Precipitation (Atmospheric), *Rainfall, Radar, Instrumentation, Rain gages, *Lake Michigan.

The increasing need for accurate measurements of precipitation over Lake Michigan led to investigations of radar and climatological methods of measurement. One radar method used dense rain gage networks and 10-cm radars to evaluate the ability of radar to measure accurately the percentage change of warm season rainfall with distance. Long-term mean percentage changes could be used to compile estimates of lake rainfall by comparing the average changes with land precipitation data. This method produced unacceptable errors. Another radar method involved adjusting the radar-indicated rainfall with shoreline rain gage data for each rain, thus minimizing inherent errors resulting from variations of radar reflectivity. By this method, warm season rainfall over certain portions of the lake could be measured with an accuracy of 2% of a long-term operational basis. Difficulties associated with radar measurements of winter season precipitation, plus exorbitant costs of rain gage and radar facilities made this method unfeasible. Mean overlake summer rainfall, estimated using climatological analysis methods appears to be reasonably accurate since the difference between the maximum and minimum possible estimated average amounts over the lake is small.
W69-00406

DETERMINATION OF INTENSITY - DURATION - FREQUENCY - AERIAL COVERAGE OF INTENSE SUMMERTIME STORMS,
Michigan State Univ., East Lansing, Dept. Agr. Eng.
E. H. Kidder.
Terminal Rep, Dep of Agr Eng, Mich State Univ, 1967. 19 p, 2 fig, 3 tab, 2 ref. OWRR Proj A-009-Mich.

Descriptors: *Precipitation (Atmospheric), Intensity, Frequency, *Rainfall, Hydrologic data, *Hydrology, Gages, Precipitation intensity, Analysis, Meteorological data, *Rainfall disposition, *Rainfall intensity.

Precipitation data was collected from a dense network of recording raingages in Ingham County, Michigan, during Aug 1965 - May 1967. Only the storm of July 12, 1966 was significant. Twenty-nine gages recorded amounts equal to or above a 1-yr frequency for 1-hr catches. The catch of 1 gage exceeds a 1 in 25-yr frequency. An analysis of 6-hour amounts showed the catch of 6 gages above a 5-yr frequency. Computer analysis of data did not show a strip pattern of rainfall. It did bring out the repeated higher catch of the 1 gage.
W69-00444

A MOISTURE-BALANCE PROFILE ON THE SIERRA NEVADA,
Nevada University, Reno, Desert Res. Inst.
Charles F. Armstrong, and Charles K. Stidd.
Preprint Series 3, Feb 1967. 20 p, 7 fig, 3 ref. OWRR Proj B-008-Nev.

Descriptors: *Runoff, *Evapotranspiration, *Runoff forecasting, *Precipitation (Atmospheric), Profiles, Orography, Surface runoff, Effective precipitation, Elevation, Moisture availability, Watersheds (Basins), Hydrologic cycle, Topography, Investigations, Forecasting.
Identifiers: Thornwaite method, Sierra Nevada, American River Basin.

Profiles have been developed showing the variation with elevation of: runoff, evapotranspiration, interception, and precipitation. Data are from the American River Basin on the west slope of the Sierra Nevada. Elevations range from 200 to 10,380 ft. Data are adjusted to annual means for a 50-yr period. Results show that precipitation can be estimated as the sum of the three other factors and the resulting precipitation profile shows the general response of precipitation to orography in this region.
W69-00461

PRECIPITATION PROBABILITIES FOR MISSISSIPPI,
Mississippi State Univ., State College.
John C. McWhorter, Kenneth R. Matthes, Jr., and Burrow P. Brooks, Jr.
Water Resour Res Inst, Rept 1966. 51 p, 41 fig, 41 tab, 7 ref. OWRR Project A-001-Miss.

Descriptors: *Atmospheric precipitation, *Rainfall, *Probability, Seasons, Computation, Meteorological data, Meteorology, Correlation techniques, Mississippi, Seasonal, Correlation analysis.

The purpose of this study was to define more accurately rainfall variations and the following objectives were designed to accomplish this goal: (1) to determine the probability of receiving less than a given amount of precipitation for weekly, monthly, seasonal, or yearly periods for 10 geographical regions in the State of Mississippi, and (2) to examine the rainfall of 1 period of time with that of another period for State College, Mississippi, to determine if the rainfall of the 2 periods could be correlated. The precipitation probability tables were designed for reference material for water-use system planners and designers. Conclusions to be drawn from this study lie not in the results themselves, but in uses made of these results.
W69-00623

THE USE OF EIGENVECTORS FOR CLIMATIC ESTIMATES,
Nevada Univ., Reno.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-00644

ANALYSIS OF QUASI-PERIODIC WEATHER DATA,
Connecticut Univ., Storrs, Civil Eng. Dept.
Chesley J. Posey.
Inst Water Resour Rep 3, Univ Connecticut, June 1967. 20 p, 19 fig, 9 ref, append. OWRR Project A-008-Conn.

Descriptors: *Weather data, Meteorology, *Analytical techniques, Turbulence, *Microenvironment.

Long-time records of daily maximum temperatures, already available on IBM cards, were studied to find out whether the frequency distribution of these values and of their first and second successive differences could serve the purpose of definitive identification, a goal that neither the harmonic analysis nor serial correlation methods have been able to achieve. Study was limited to records of up to 36 years, and included but three different geographical locations. The empirical evidence that each of the three frequency distributions tended to converge toward a fixed relationship as the period was lengthened was strong. The best discriminator between the locations seemed to be the distribution of daily maximums. The distributions of the first and second successive differences at the different stations were so similar as to give rise to formulation of an hypothesis of similarity of global atmospheric turbulence. The curves presented are of interest in comparing the climatological environments. A computer program is given which can be used to extend the study to include a wider range of data.
W69-00670

2C. Snow, Ice, AND Frost

A PRINCIPLE INVESTIGATION OF THE COMBINED HYDROLOGICAL AND MASS BUDGET OF A CRITICAL GLACIER BASIN ON THE RIM OF THE NORTH PACIFIC HIGH, ALASKA-CANADA BOUNDARY RANGE,
Michigan State Univ., East Lansing, Glaciological and Arctic Sciences Inst.
Maynard M. Miller.
Inst Water Res Prog Rep, Michigan State Univ, Feb 1967. 17 p, 3 fig. OWRR Proj B-002-Mich.

Descriptors: *Hydrologic budget, *Glaciers, Alaska, Hydrologic cycle, Weather forecasting, Ablation, *Water balance, Surface runoff, Melting, Heat budget.

This is a study of glacio-fluvial runoff as related to meteorological and hydrological conditions. Data are from the Lemon-Ptarmigan Glacier on the Alaska-Canada boundary range. The glacier is situated in the interaction zone between the main circulations of the continental anti-cyclone and the cyclonic North Pacific Low. This system is acutely sensitive to climatic perturbations of continental significance. The objective is to develop a prototype investigation of the water balance of a climatologically critical zone and to relate the trends of the water, ice, and heat budget to the long-term regional glacier pattern. This information will contribute to our ability to predict hydrological trends in other regions of North America. Measured runoff losses are compared with percolation water recaptured by freezing and capillary retention and with the total retained solid water. The water-ice budget is analyzed and related to secular temperature and precipitation trends and to the shifting position of the Arctic front. Instrumentation and techniques used to facilitate the research include recording thermographs, precipitation and stream gages, ablation stake networks, seismic profiles,

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standard meteorological equipment, test pits, and rammsonde profiles.
W69-00445

DEVELOPMENT AND TESTING OF SNOW PACK ENERGY BALANCE EQUATIONS,
Environmental Science Services Admin, Washington, D C.
E. A. Anderson.
Water Resour Res, Vol 4, No 1, pp 19-37, Feb 1968. 19 p, 12 fig, 1 tab, 18 ref.

Descriptors: Snow, *Snow surveys, *Snowmelt, *Energy balance, Melting, Runoff, *Runoff forecasting, Heat transfer, Thermodynamics, Mathematical analysis, Hydrology, Water sheds, Wind (Meteorology), Bibliographies, Models.
Identifiers: Mathematical models, *Snow pack.

A method was developed for computing the energy balance of a snowpack on a continuous basis. Estimates or measurements are required of net radiation or its components, air temperature, dewpoint, atmospheric pressure, amount and temperature of precipitation, surface snow density, and a wind function relating the vapor pressure gradient to moisture transfer. The 1954 Lower Meadow lysimeter studies showed good agreement between computed and observed values for snowpack runoff and snow surface temperature. A snowmelt and accumulation model was constructed by combining energy balance equations with relationships describing other components of the snowpack accumulation and ablation process. The Stanford Watershed Model is used to determine the time delay of water leaving the snowpack to the streamflow gaging station. The model gives a reasonable simulation of the observed mean daily flow hydrograph and seasonal areal snow cover plot using 5 yr of data from the Central Sierra Snow Laboratory. The model approximates the actual physical processes and will be valuable in future snow hydrology investigations. (USBR)
W69-00585

COMPARISON OF SNOW INTERCEPTION BY A HARDWOOD AND A CONIFER FOREST,
Maine Univ, Orono, School of Forestry and Water Resources Research Center.
C. E. Schomaker.
Res in the Life Sci, Vol 16, No 2, pp 35-43, Summer 1968. 9 p, 3 fig, 1 tab, 6 ref. OWRR Project A-005-Me.

Descriptors: *Interception, *Snow, *Rainfall, Snowmelt, Conifers, Hardwood, Pastures, Maine.
Identifiers: Snowfall interception.

The interception of snow and rain by a hardwood forest and a conifer forest near Orono, Maine are compared in a study made in 1965-1967. Interception by the conifers ranged from 35-37% of precipitation in winter and 27-35% in spring and summer. Interception by hardwoods ranged from 12-18% in winter and from 7-14% in spring and summer. In one study of snow accumulation on the ground, on Feb 2, snow depths were 16.0 in. under conifers, 24.5 in. under hardwoods, and 28.0 in. in open pasture. Snow melted off pasture first, followed by the hardwood and last, the conifer forest floor. (Knapp-USGS)
W69-00688

2D. Evaporation and Transpiration

PRELIMINARY LYSIMETRIC INVESTIGATIONS AT THE UNIVERSITY OF NEBRASKA FIELD LABORATORY, MEAD,
Nebraska Univ., Lincoln.
Norman J. Rosenberg.
Nebraska Water Resour Res Inst, Hort Proj Rep 60, 1966-1967. 111 p, 43 fig, 18 tab, 48 ref, 2 append. OWRR Project A-001-Nebr.

Descriptors: Advection, *Climatology, *Evapotranspiration, Estimating equations, Evapotranspiration control, Water conservation, *Lysimeters, *Regression analysis, Instrumentation, Bibliographies.

The installation of lysimeters, meterological instrumentation and data logging systems at the Nebraska Field Laboratory at Mead, Nebraska is discussed and illustrated. A preliminary study of wind conditions over the experimental field is included as well as lysimetric measurements of evaporation from bare soil during the summer and fall of 1966. Equations are developed through multiple regression techniques on commonly measured meteorological parameters to predict evaporation from bare soil. Effectiveness of antitranspirant materials on water economy of alfalfa summarized. (E. C. Reed-Nebr)
W69-00655

SOME EFFECTS OF CONTINUOUS ANTI-EVAPORATION FILMS,
Missouri University, Rolla and Texas A and M University, College Station.
Bobby G. Wixson, and William B. Davis.
Proc of 3rd Annu Amer Water Resources Conf, pp 170-174, Nov 8-10, 1967. 3 fig, 4 ref.

Descriptors: *Biochemistry, *Evaporation control, *Monomolecular films, Hexadecanol, Octadecanol, Algae, Bacteria, Oxygen demand, Biodegradation.
Identifiers: *Anti-evaporation films.

The ecological effects of a continuous anti-evaporation film of hexadecanol and octadecanol were studied in experiments designed to simulate field conditions as closely as possible without the size and complexity of natural systems. Light banks simulated sunlight energy, with photoperiods from 8 AM to 8 PM. Air and water temperatures were maintained at 22 deg C. The 20 gal glass aquaria were inoculated with pond water and algae for 3 consecutive 30 day tests. Half of the systems were filmed with a 1:1 mixture of hexadecanol and octadecanol at a rate of 0.05 pounds per acre per day. The number of bacteria increased in filmed systems, and biodegradation of the film caused oxygen demand. The film reduced oxygen diffusion rate by 10-15%. Initially algae growth was inhibited but the biodegradation of the film added nutrients which were used by some species of algae which increased in growth after 15 days. Reduced surface tension caused some algae to sink instead of float. (Knapp-USGS)
W69-00699

2E. Streamflow and Runoff

FLOODS FROM FOREST COMPARED TO THOSE FROM FARMLAND,
Colorado State University, Fort Collins.
Songthara O. Kar.
Interim Rep, Natur Resour Center, Colo State Univ, June 1967, 124 p, 4 fig, 16 tab, 2 appnd, 57 ref, disc. OWRR Project A-002-Colo.

Descriptors: *Floods, Watersheds (Basins), Watershed management, Cultivated lands, Forests, Grasslands, Deserts, Flood forecasting, Forecasting, *Hydrographs, Computers, Analysis, *Runoff, *Runoff forecasting.
Identifiers: Flood frequency.

An exploratory study on floods from forest compared to those from farmland was performed as an extension of a thorough study of hydrograph rise times. Fifty-one watersheds were classified, using as a criterion the watershed coverage, into 4 groups: forest, cultivated, grass, and desert. Equations for predicting rise times and 10-yr flood peaks were derived in simple and multiple regression analyses by computer. The best equations obtained were used to study the effects of changing the watershed coverage on rise times and flood peaks by using 2 average watersheds. No conclusions concerning the trend of behavior of watersheds compared are warranted. Detailed information on watershed coverage and condition must be secured before any further work is to be performed.
W69-00398

SOME ASPECTS OF TIME SERIES ANALYSIS IN HYDROLOGIC STUDIES,
U S Geological Survey, Washington, D C.
N. C. Matalas.
Proc of Hydrol Symp No 5, National Research Council of Canada, pp 271-309, Feb 1966. 39 p, 50 ref.

Descriptors: *Time series analysis, *Hydrology, *Streamflow forecasting, Mathematical studies.

Statistical techniques used to study the characteristics of hydrologic time series are reviewed and their use is explained. In time series analysis, an attempt is made to estimate and reconstruct the properties of the generating process of a phenomenon from the observed time series followed by the phenomenon. The estimates are made in either the time or frequency domain by the use of covariance or spectral functions, each of which is a Fourier transform of the other. Covariance seems the more appropriate for extrapolation into future time, but spectral techniques are easier to use to predict responses of river systems to stochastic inputs, particularly with linear systems. Autocorrelation in stationary hydrologic time series of annual events is attributed to storage and to persistence in precipitation and evapotranspiration, and much of the variance is accounted for by low frequencies. Annual floods have very little serial correlation. The assumption of first-order linear autoregression processes to account for effects of persistence is practical because the mathematical operations are tractable. (Knapp-USGS)
W69-00422

A MATHEMATICAL MODEL FOR SIMULATING THE HYDROLOGIC RESPONSE OF A WATERSHED,
Purdue Univ, Lafayette, Ind.
L. F. Huggins, and E. J. Monke.
Water Resour Res, Vol 4, No 3, pp 529-539, June 1968. 11 p, 9 fig, 1 tab, 14 ref.

Descriptors: *Watersheds, *Simulation, Runoff, Surface runoff, Storms, *Mathematical analysis, Drainage basins, Infiltration, Hydrographs, Soil moisture, Models, Slopes, Outflows, Hydrology, Grid systems.
Identifiers: *Mathematical models, Small watersheds, Rainfall-runoff relation, Interception, Storm runoff, Inflow.

A general mathematical model was developed to simulate surface runoff from watersheds. Based upon integration of the concepts of physical hydrology into quantitative relationships, the model avoids the use of lumped parameters by delineating the watershed as a grid of small independent elements. The resultant freedom from fundamental assumptions of the form of the system equations and from the permissible small areal resolution of the model permits study of complex combinations of watershed and storm conditions. Application of the model to two small watersheds indicated that additional research is needed to better define the relationships for surface runoff and infiltration and to improve the reliability of simulated runoff hydrographs. (USBR)
W69-00568

A NUMERICAL SOLUTION OF THE EQUATIONS OF MOTION AS APPLIED TO SURFACE FLOW,
New Mexico State Univ., University Park.
Ahmed Yousef Abdel-Razaq, and John W. Hernandez.
Eng Exp Sta, Tech Rep 36, Dec 1966. 90 p, 15 tab, 30 ref, 2 append. OWRR Project A-001-NMex.

Descriptors: Hydrology, Urban hydrology, Runoff, *Surface runoff, Hydraulics, Open channels, Watersheds (Basins), *Numerical method, Flood routing, Computer models, Synthetic hydrology, *Overland flow, Unsteady flow, *Motion, Rainfall, Impervious soils, Equations, Bibliographies, Demonstration watersheds.
Identifiers: Watershed studies, Surface hydrology.

A new technique is presented for the solution of the unsteady flow equations for the ideal case of a constant-slope open channel with lateral inflow. Lateral inflow is assumed to be constant with distance but variable in time. The proposed techniques may be applied to the solution of problems of surface runoff. The one-dimensional, non-linear, partial differential equations of motion and continuity are derived and transformed into a system of ordinary, nonlinear, differential equations. This set of equations may then be solved numerically to give the velocity, depth of flow, or area, at any point along the channel. The numerical procedure consists of solving the equations for the derivatives of the velocity and depth, or area, with respect to time at each nodal point along the channel for a particular time. Starting with the known initial conditions and utilizing Taylor's series, the velocity and the depth, or the area of flow, can be predicted after an increment of time. The numerical solution was shown to converge.
W69-00636

REGIONAL DRAFT STORAGE RELATIONS IN WEST-CENTRAL ALABAMA,
U. S. Geological Survey, Tuscaloosa, Alabama, Water Resources Division.
Patrick O. Jefferson.
U S Geol Surv Prof Pap 600-C, pp C182-C184, 1968. 3 p, 4 fig, 1 tab, 1 ref.

Descriptors: *Water resources, *Surface waters, *Draft-storage curves, *Water yield, *Safe yield, Water storage, Watershed management, Streamflow, Discharge (Water), Alabama.
Identifiers: *Draft-storage relations, Median 7-day low flow.

In a 10-county region of west-central Alabama, within-year storage can provide draft rates ranging up to 50% of the average flow of streams. Storage requirements can be estimated on the basis of average flow alone, but the standard error of estimate can be reduced by including median 7-day low flow as a secondary variable. Multiple regressions for estimating storage requirements for draft rates of 25 to 50% of the average flow are combined in a single coaxial diagram which has regional application. Draft-storage frequency curves and curves showing regional relations between storage required and average flow are presented. (Knapp-USGS)
W69-00682

SERIAL CORRELATION OF ANNUAL FLOODS,
U S Geological Survey, Washington, D. C., Water Resources Div.
P. H. Carrigan, and Carl S. Huzzen.
Proc of the 12th Congr, Int Hydrol Symp, pp 322-328, Sept 1967. 7 p, 4 fig, 1 tab, 6 ref.

Descriptors: *Time series analysis, *Floods, *Streamflow, *Stochastic processes, Markov processes.
Identifiers: Annual floods.

A study of streamflow records of 45 gaging stations, well distributed over the United States, was undertaken to determine serial correlation of annual floods, to seek stochastic processes most descriptive of serial correlation, and to relate serial correlation to hydrologic variables. The first- and second-order serial correlation coefficients for annual floods appear to be greater than zero at a significant number of the sites considered in this study. No dominant stochastic process was found in study of these records. The possibility of serial correlation of annual floods appears to increase if base flow enhances the magnitude of flood discharges. First-order serial correlation coefficients of annual flows and of annual floods seem to be directly related. (Knapp-USGS)
W69-00686

RESISTANCE TO FLOW IN SAND CHANNELS,
U S Geological Survey, Fort Collins, Colorado.
Everett V. Richardson, and Daryl B. Simons.
Proc of the 12th Congr, Int Ass for Hydraul Res, pp 141-150, Sept 1967. 10 p, 4 fig, 12 ref.

Descriptors: *Alluvial channels, *Channel morphology, *Flow resistance, *Regime, Roughness (Hydraulic), Equations.
Identifiers: Navier-Stokes equation.

Relations are presented for estimating resistance to flow for plane bed, rippled bed, dunes, and antidunes. With plane bed, energy dissipation results from grain roughness. With ripples, it results from form roughness. With dunes, it results from form roughness and grain roughness if dunes are small in comparison to the scale of the system. If dunes are so large that they cannot be considered roughness elements but changes in cross section, then energy dissipation also results from the acceleration and deceleration of the flow as well as from the grain and form roughness. With antidunes, energy dissipation results from grain roughness, acceleration and deceleration of the flow and breaking waves. There is not a general resistance-to-flow equation for equilibrium flow in a sand channel because (1) bed configuration determines whether the flow is uniform or nonuniform and steady or unsteady; (2) there are 4 types of energy dissipation; and (3) there is a range in shear stress (transition) where bed form may range from dunes to plane bed or antidunes. A relation is also given for predicting bed from given stream power and sand size. (Knapp-USGS)
W69-00687

FLOODS FROM HURRICANE BEULAH IN SOUTH TEXAS AND NORTHEASTERN MEXICO, SEPTEMBER-OCTOBER 1967,
U S Geological Survey, Austin, Texas, Water Resources Division.
R. V. Grozier, D. C. Hahl, and A. E. Hulme.
Tex Water Develop Board Rep 83, 195 p, Sept 1968. 38 fig, 14 tab.

Descriptors: *Floods, *Texas, *Mexico, *Historic flood, *Hurricanes, *Rain, Discharge (Water), Regional floods, Stage-discharge relations, Rio Grande.
Identifiers: *Hurricane Beulah, Estuary dilution, Record rainfall.

Floods produced by Hurricane Beulah during Sept and Oct 1967 exceeded maximum previous stages on 5 Texas river basins by amounts ranging from 2.7 ft at Guadalupe River near Tivoli to 9.2 ft at Arkansas River near Skidmore. Medio Creek near Beeville had a discharge 4.12 times the previous maximum and 6.0 times the 50-yr flood. The inflow to Lake Corpus Christi was over 4.5 times the volume of the lake. Corpus Christi Bay received 1.5 times its normal volume and San Antonio bay, 3 times its volume. Most of the saline water was flushed out. Water levels rose in shallow wells because of infiltration of floodwater and rainfall, and because of water pouring into many flooded wells. Flooding along the Rio Grande exceeded all previous maximum measurements. A 4000 sq mi area of South Texas was inundated. Rainfall of 25 in. was common in Texas and as much as 35 in. was measured in Mexico. Precipitation, discharges, water quality, and groundwater levels are tabulated. (Knapp-USGS)
W69-00690

METHOD OF VOLUME-DIVERSION ANALYSIS OF A STREAM,
U S Geological Survey, Washington, D. C., Water Resources Division.
M. R. Collings.
U S Geol Surv Prof Pap 600-C, pp C199-C203, 1968. 5 p, 4 fig, 2 tab, 3 ref.

Descriptors: *Diversion, *Water management (Applied), *Duration curves, *Prior appropriation, Hydrographs, Statistical methods.
Identifiers: Volume-diversion analysis, Millers River, Mass, Flow frequency.

A simple method is proposed for estimating the probability of the potential volume of diversion available after prior demands on flow are satisfied downstream from a selected diversion site. The volume of divertable flow obtainable in excess of a specified discharge is computed from the selected class discharge limits used in calculating flow-duration data. The magnitude and frequency of these volumes are then determined. From the analysis of mean daily flows, relations can be derived to determine (1) potential volume of diversion, (2) recurrence interval, (3) size or rate of diversion, and (4) probable number of days in a year when diversions are possible. The results of an analysis of Millers River, Massachusetts are presented in the form of frequency curves. (Knapp-USGS)
W69-00694

THE BOUNDARY CONDITIONS IN THE IMPLICIT SOLUTION OF RIVER TRANSIENTS,
U S Geological Survey, Washington, D. C., Water Resources Division.
Chintu Lai.
U S Geol Surv Prof Pap 600-C, pp C204-C210, 1968. 7 p, 3 fig, 7 ref.

Descriptors: *Unsteady flow, *Streamflow, *Stage-discharge relation, *Mathematical studies, *Digital computers, Computer programs, Open channel flow, Velocity.
Identifiers: *River transients, *Boundary conditions, Finite-difference methods, Implicit method.

Transient riverflow in a given reach at a particular time can be defined by partial differential equations and appropriate boundary conditions. Consideration of physical properties of the riverflow gives 4 different sets of boundary conditions. In solving these equations using the implicit method all unknowns at the advanced time line have to be found simultaneously; therefore, different combinations of known boundary data leave different sets of unknown to be solved implicitly. Computer programs have been written to handle different boundary-value problems separately. Test runs have indicated that transient flows with all 4 boundary conditions can be treated adequately, and have shown that good agreement exists between computed and observed values. The boundary conditions treated are: (1) Stages given at the upstream and downstream ends of the reach; (2) Discharges given at each end; (3) Stage given at the upstream end and discharge at the downstream end; (4) Discharge given at the upstream end and stage at the downstream end. (Knapp-USGS)
W69-00697

AN IMPLICIT METHOD FOR NUMERICAL FLOOD ROUTING,
North Carolina State University, Raleigh.
Michael Amein.
Water Resources Res, Vol 4, No 4, pp 719-726, Aug 1968. 8 p, 2 fig, 1 tab, 18 ref.

Descriptors: *Digital computers, *Floods, *Flood routing, *Mathematical models, Hydraulics, Unsteady flow, Open channel flow.
Identifiers: *Implicit method, *Numerical solutions, Partial differential equations, Digital computer method.

In application to flood routing, the numerical solution of the complete equations of unsteady flow is described. This implicit method is both fast and accurate and can be established based on: (+) a centered difference scheme for representing the primary differential equations in finite difference form, and (b) simultaneous solutions of the finite difference equations for each time step. The dif-

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ference equations constitute a system of nonlinear algebraic equations that can be solved on a digital computer by rapidly convergent procedures based on the generalized Newton iteration method. A distinguishing feature of the linear system is that the matrix of coefficients contains few nonzero elements, which facilitate fast solutions. It was found that when the implicit method was applied to a number of representative problems in flood flows, the computations were stable and converged rapidly toward the final solutions. The method can be efficiently applied to the study of flood movement. (Llaverias-USGS)
W69-00700

2F. Groundwater

CORRELATION OF TRACE ELEMENTS IN GROUND WATER AND AQUIFERS WITHIN THE CONNECTICUT RIVER BASIN.

Water Resour Res Inst, Conn, May 1967. 4 p. OWRR Project A-007-Conn.

Descriptors: *Trace elements, *Aquifers, *Groundwater, Groundwater geology, Water quality, Minerals, Spectroscopy, Bedrock, Rocks, Chemical analysis.
Identifiers: Connecticut River Basin.

This paper is a notice of the completion of a OWRR research project. Ultraviolet emission spectrography was employed to obtain reasonably precise semiquantitative data for some trace elements of certain minerals from various bedrock units in Connecticut. The elements determine were Ag, Ba, Be, Ca, Cu, Ga, Mn, Pb, Sn, Ti, and Zr. Minerals analyzed were quartz, feldspars, biotite, and magnetite. Most of the elements (Ag, Ba, Be, Ga, Pb, Sn, and Ti) showed concentration variations that were systematically related to specific rock units. The above data constitute partial achievement of the immediate objectives of this project, which include: (1) the determination of trace element concentrations in minerals from bed rock units and in ground-water samples from various parts of Connecticut; and (2) sampling and analyses of minerals from aquifers (bedrock units and unconsolidated deposits) and ground water from the Connecticut River Basin and their correlation based on trace element concentrations.
W69-00399

REGIONAL GEOLOGY AND GROUNDWATER HYDROLOGY OF THE SAHIL AREA, TUNISIA,
U S Geological Survey.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00429

GROUND-WATER RESOURCES OF THE ACU VALLEY, RIO GRANDE DO NORTE, BRAZIL,
U S Geological Survey.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00430

GROUND-WATER HYDROLOGY OF THE SEVIER DESERT, UTAH,
U S Geological Survey.
R. W. Mower, and R. D. Feltis.
U S Geol Surv Water-Supply Pap 1854, 75 p, 1968. 15 fig, 7 plate, 9 tab, 38 ref.

Descriptors: *Water sources, *Groundwater recharge, *Utah, Water quality, Evapotranspiration, Groundwater movement.
Identifiers: *Sevier Desert.

A cooperative hydrologic study was made of the Sevier Desert to determine amount and location of recharge, discharge, pumpage, water storage, and pumping effects on water levels. Most recharge to groundwater reservoirs results from water entering alluvial fans as percolation from streams, irrigation ditches, and irrigated fields. Leakage from the Central Utah Canal is a major source of recharge to the water-table aquifer. Most groundwater is suitable for domestic and stock uses. Water discharged by withdrawal from wells increased from 2,000 ac ft in 1950 to 30,000 ac ft in 1964 and water levels declined from 4 ft to 7 ft for the same period. In the 440,000 acres of the Sevier Desert that support phreatophytes, and estimated 135,000-175,000 ac ft of groundwater is consumed by evapotranspiration. Consumptive waste of groundwater by vegetation of little or no value (principally saltcedar and pickleweed) is not great but will increase if saltcedar spreads into native meadow pastures, along canal and drain banks, and into surface reservoirs. About 120,000 ac ft of water can be obtained from storage by lowering the artesian aquifer water level 20 ft. (Llaverias-USGS)
W69-00432

GEOPHYSICAL LOGGING AND HYDRAULIC TESTING, PAHUTE MESA, NEVADA TEST SITE,
U S Geological Survey, Las Vegas, Nevada.
Richard K. Blankennagel.
Ground Water, Vol 6, No 4, pp 24-31, July-Aug 1968. 8 p, 9 fig, 11 ref.

Descriptors: *Borehole geophysics, *Logging (Recording), *Hydraulic properties, *Water wells, Electrical well logging, Tracers, Flowmeters.
Identifiers: *Testing, Packers, Caliper logs, Temperature logs.

Studies performed by the U S Geological Survey for the Atomic Energy Commission in relation to underground nuclear explosions at the Nevada Test Site involve geophysical logging and hydraulic testing in deep exploratory holes at Pahute Mesa. Electric logs are used to identify lithology, for correlation and to locate potential water-bearing zones, usually fractured welded tuff and rhyolote. Caliper logs are essential to determine borehole diameter for selection of packer seats, for tracer-survey computations, and for proper interpretation of other geophysical logs. Temperature logs indicate water movement and water entry into boreholes. Fluid resistivity logs are made at the same time as spontaneous potential logs to aid in spontaneous potential interpretation and to detect zones of fresh water entry. Tracer surveys and flow meters are used to study water circulation. Hydraulically inflated straddle packers are used in water injection and swabbing tests for water yielding potential of isolated intervals in the borehole. Static water levels of selected intervals are also obtained. (Knapp-USGS)
W69-00434

THE RELATIONSHIP BETWEEN SPECIFIC CAPACITY AND AQUIFER TRANSMISSIBILITY IN THE HOUSTON AREA, TEXAS,
U S Geological Survey, Houston, Texas.
R. K. Gabrysch.
Ground Water, Vol 6, No 4, pp 9-14, July-Aug 1968. 6 p, 6 fig, 1 tab, 4 ref.

Descriptors: *Water wells, *Aquifers, *Specific capacity, *Pump testing, *Transmissivity, Well screens, Aquifer characteristics, Hydraulics, Storage coefficient.
Identifiers: *Well efficiency, Pumping tests, Recovery tests, Well development, Houston, Texas.

Tests of wells owned by Houston, Texas were analyzed and comparison of the results with theoretical transmissibility-specific capacity curves showed that the wells are not completely developed. Average thickness of sand beds screened ranges from 340-605 ft in the 7 well fields. The 55 tests showed ranges in aquifer permeability from 125-432 gpd per sq ft, and ranges in average transmissivity from 96,000 to 172,000 gpd per ft. Measured specific capacities were based on 1-hour recovery tests. Shorter tests showed misleading higher values. All were lower than calculated theoretical values. Wells drilled since 1955 averaged 69% of theoretical transmissivity and wells drilled before 1955 averaged 72%. The better performance of the older wells may be because of gradual development by pumping through the years. It is suggested that well drillers employ 1-hour or longer, properly conducted recovery tests to determine whether wells are properly constructed and developed. (Knapp-USGS)
W69-00435

POINT DILUTION METHODS OF INVESTIGATING GROUND WATER FLOW BY MEANS OF RADIOISOTOPES,
Walter Drost, Dietmar Klotz, and Arnd Koch.
Water Resour Res, Vol 4, No 1, pp 125-146, Feb 1968. 22 p, 15 fig, 3 tab, 30 ref.

Descriptors: *Tracers, *Radioactive isotopes, Dyes, Ground water, *Wells, Dams, Permeability, Piezometers, Porous materials, Model tests, Underseepage, Field tests, Seepage, Bibliographies, *Groundwater flow.
Identifiers: Radiation detectors, Gold isotopes, Foreign testing, West Germany, *Dilution method, *Water wells.

The distortion of the flow field by a well must be known to apply the point dilution method of measuring ground-water flow by tracers. The distortion can be calculated if aquifer permeability is less than or equal to gravel pack permeability, and if gravel pack permeability is less than or equal to well screen permeability. The tracer must be adequately mixed during the dilution procedure. Experiences obtained from model tests are applied to field investigations. Peak-to-peak and total count methods were used in wells having a vertical flow to determine depths and rates at inflow and outflow. The direction of ground-water flow was determined by the point dilution method; a radioactive tracer is injected into the well screen water column and measured by a collimated probe that is sensitive to the direction of incident radiation. Using tracers that are fixed on the soil is advisable; Gold 198 is the most suitable tracer. Strong, vertical currents in a well present a serious obstacle to field measurements of the rate and direction of ground-water flow. (USBR)
W69-00587

WATER-LEVEL PROBE,
National Reactor Testing Station, Idaho Falls, Ida.
K. H. McGary, M. Wilhelmsen, and P. Boren.
J Hydrol, Vol 6, No 3, pp 225-236, June 1968. 12 p, 8 fig.

Descriptors: Instrumentation, Measuring instruments, Wells, Sensors, Water surface, Water surface profiles, *Liquid level gages, Electrodes, Recording systems, Electrical conductance, Ground water, Phreatic line, Water table, *Water stage recorders.
Identifiers: *Water level, Water wells, Probes (Instruments).

A water-level probe designed for recording surface levels in wells can be applied to any system requiring monitoring and control of liquid levels. Desirable features of the instrument were: a probe for small-diameter well casing; self-contained, lightweight, and rugged; operable over long periods without battery replacement or maintenance; sealed against wind, dust, rain, and snow; able to withstand temperature variations from 100 deg F to minus 40 deg F; and exhibiting an accuracy of plus or minus 0.02 ft at well depths of 600 ft. The major problem encountered was designing a sensitive and reliable probe. Probes using water conductivity as the sensing mechanism became corroded, lost conductivity, and gave erroneous readings because of water and mineral salt bridging the electrodes. Three types of probes were developed to overcome these problems. One was a float-operated mercury switch not dependent on water conductivity; the other 2 were conductive probes using stainless steel

with long pointed electrodes. Design details, applications, and precautions are given for using the probes. (USBR)
W69-00591

TIME VARIANT GROUND WATER FLOW BY RESISTANCE NETWORK ANALOGUES,
Birmingham Univ, Great Britain.
Robin Herbert.
J Hydrol, Vol 6, No 3, pp 237-264, June 1968. 28 p, 17 fig, 2 tab, 12 ref.

Descriptors: Ground water, *Groundwater flow, *Electric analogs, Time, Steady flow, Analogs, Two-dimensional, Water table, *Drawdown, Models, Movements, Mathematical analysis, Three-dimensional, Wells, Electrical resistivity.
Identifiers: Mathematical models, Great Britain.

A sudden water table movement may cause earth dams to collapse, riverbanks to fall, wells to run dry, or heavy machinery to bog down in saturated soil. A general method for simulating unconfined ground-water flow is available for predicting and minimizing such an occurrence. Factors governing water table movement are described, and a method for studying the flow is developed. The technique represents the continuous fall of the water table in a stepwise manner; a method is described for smoothing out discontinuities induced by such a technique. The solution to a simple problem is presented with experimental details to demonstrate how the technique is applied to a network analog modeling time-variant flow. The technique is tested against alternative solutions of flow systems in: (1) two dimensions, (2) three dimensions, and (3) radial symmetrical form. Accuracy of the analog solution is high. Isolated solutions of certain idealized unconfined flow systems existed prior to this work; however, any three-dimensional time-variant unconfined ground-water system may be represented, using the technique described. (USBR)
W69-00594

IN-SITU DETERMINATION OF AQUIFER PARAMETERS FOR USE IN THE DRAINAGE FUNCTIONS,
Utah State Univ, Logan.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00602

ANALYSIS AND PREDICTIVE METHODS FOR GROUND WATER FLOW IN LARGE HETEROGENEOUS SYSTEMS,
Battelle Memorial Institute, Richland, Wash.
R. William Nelson, and Dennis B. Cearlock.
Pap, Proc Ser No 4, Symp Amer Water Resour Ass, San Francisco, Calif pp 301-318, Nov 1967. 18 p, 9 fig, 12 ref.

Descriptors: *Ground water, *Groundwater flow, Permeability, Aquifers, Porous materials, Heterogeneity, Water table, Forecasting, Mathematical analysis, *Boundary values, Computer programming, Analysis, Reservoirs, Energy dissipation, Hydrology.
Identifiers: Ben Franklin Resvr, Wash, Hanford Project, Wash, Boundary conditions, Groundwater management, Mathematical models.

Ground-water flow in heterogeneous porous materials was analyzed to determine the effects on the ground-water system of the proposed Ben Franklin Reservoir in Wash. The analysis method has 3 parts: (1) in-place determination of invariant flow system characteristics; (2) predicting new flow conditions from altering boundary conditions; and (3) using predicted results to answer practical problems such as the possible movement of contaminants. The paper discusses a new energy dissipation method for in-place permeability measurement to determine distribution. Permeability distribution and boundary conditions are used to set up a new boundary value problem. The boundary value problem interrelates all pertinent variables and provides a skeleton model for predicting future ground-water flow conditions. The solution gives new ground-water potentials resulting from changes in boundary conditions. The analysis sequence gives a better representation at actual field conditions and offers advantages of directly specifying field data required, which will realize savings by eliminating nonessential traditional field measurements. (USBR)
W69-00604

EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
US Geological Survey, Denver, Colo.
Robert W. Stallman.
Pap, Proc Ser No 4, Symp Amer Water Resour Ass, San Francisco, Calif, pp 126-134, Nov 1967. 9 p, 4 fig, 18 ref.

Descriptors: *Ground water, *Aquifers, Hydrology, Moisture content, Permeability, Bibliographies, Groundwater flow, Drawdown, Time, Wells, Water table, Electric analogs, Radioactive isotopes.
Identifiers: Evaluation, Transmissibility coeff, Transmissivity, Theis nonequilibrium method, Leaky aquifers, Depth.

Complicated ground-water flow systems can be studied in detail by applications of electric analogs or digital computers. Aquifers and their response to applied stress could not be studied economically 15 yr ago. Examples of recently developed techniques are discussed. Graphs show: (1) comparisons of Theis and Hantush analyses of recovery data; (2) auxiliary-type curves from Boulton, showing match to drawdowns observed at midthickness in an unconfined aquifer; (3) apparent specific yield from measurements of moisture content; and (4) depth vs temperature in a formation having low permeability where ground-water flow is vertical. (USBR)
W69-00605

RECHARGE FROM INDUCED STREAMBED INFILTRATION UNDER VARYING GROUND-WATER-LEVEL AND STREAM-STAGE CONDITIONS,
Minnesota Univ., Minneapolis.
William C. Walton, David L. Hills, and Gordon M. Grundeen.
Water Resour Res Center Bull 6, June 1967. 43 p, 19 fig, 3 tab, 19 ref. OWRR Project A-014-Minn.

Descriptors: *Surface-groundwater relationships, Hydrographs, *Safe yield, Influent streams, Saturated flow, *Streambeds, *Streamflow, Aquifers, Artificial recharge, Permeability, Storage coefficient, Water table, Drawdown, Groundwater recharge, Observation wells, *Induced infiltration, *Analog computers.

Recharge from induced streambed infiltration can be estimated with data on streambed infiltration rates, surface water temperatures, ground water levels, and stream stages. However, estimates of recharge are not valid unless it is recognized that: rate of leakage through a streambed increases in direct proportion to declines in water table until water levels have receded to stages below the streambed; after the water table recedes below the streambed, rate of leakage remains constant and at a maximum value, provided stream stage and temperature do not change. Incorrect water table declines and incorrect potential yields of well fields will be computed if it is assumed that induced streambed infiltration continuously increases in direct proportion to drawdown beneath the streambed regardless of water table stage. An aquifer-stream system for which hydrogeologic data are available was studied using electric analog computers and analytical methods. Results of these computer studies demonstrate that much greater drawdowns are computed for an aquifer-stream system when maximum infiltration conditions are taken into account than when maximum infiltration conditions are ignored.
W69-00620

DESIGN AND CONSTRUCTION OF A HORIZONTAL VISCOUS FLOW MODEL,
Delaware Univ., Newark.
R. D. Varrin, and H. Y. Fang.
Lehigh Univ Affiliated Inst, Ground Water, Vol 5, No 3, July 1967. 7 p, 3 fig, 22 ref. OWRR Project A-004-Del.

Descriptors: Bibliographies, *Analog models, *Viscous flow, Ground water, *Groundwater flow, *Aquifers, Transformations, Model tests, Fluid flow, Porous media, Water wells, Drainage, Permeability, Underground water storage.

This horizontal viscous flow model with infinite areal extent can be used for most well flow problems, whether 2-dimensional or 3-dimensional, steady or nonsteady, single aquifer or multiaquifer. This model can be used in the field of soil mechanics for subsurface drainage problems. The design includes scale model analysis and the application of conformal mapping techniques for simulating an ideal aquifer. Construction, calibration, and test procedures for the model are described. The apparatus has proved to be a valuable research tool and an excellent teaching aid.
W69-00628

HYDRAULIC MODEL STUDY OF NONSTEADY FLOW TO MULTIAQUIFER WELLS,
Princeton Univ., New Jersey.
Roger J. M. De wiest.
J Geophys Res, Vol 71, No 20, pp 4799-4810, Oct 1966. 12 p, 11 fig, 17 ref. OWRR Project A-004-Del.

Descriptors: *Hydraulic models, Model studies, *Non-uniform flow, *Aquifers, Water wells, Wells, Hydraulics, Mathematical models.

This paper appraises an analytical study of nonsteady flow to multi-aquifer wells by means of the flow in a horizontal Hele-Shaw apparatus. Design and calibration features of the analog are described in detail for a well which penetrates 2 parallel overlying aquifers of infinite extent. The agreement between analytical solutions derived from a mathematical model, neglecting well losses, and experimental results from the physical analog is found to be very good.
W69-00629

HYDRAULIC MODEL STUDY OF NONSTEADY FLOW TO MULTIAQUIFER WELLS,
Princeton Univ., Princeton, N. J.
Roger J. M. De Wiest.
Prog Rep 1, Groundwater Flow Systems in Del-Md-Va-Peninsula, June 1966. 41 p, 9 fig, 15 ref. OWRR Project A-004-Del.

Descriptors: *Hydraulic models, Hydraulic engineering, Groundwater, Model studies, *Aquifers, Subsurface waters, Confined water, Fluid flow, Boundaries (Surfaces), Mathematical studies, Mathematical models, *Subsurface flow, *Unsteady flow, *Water wells.

The paper appraises an analytical study of nonsteady flow to multiaquifer wells by means of the flow in an horizontal Hele-Shaw apparatus. Design and calibration features of the analog are described in detail for the case in which a well penetrates 2 parallel overlying aquifers of infinite extent. The agreement between analytical solutions derived from a mathematical model, neglecting well losses, and experimental results from the physical analog is found to be very good.
W69-00630

GEOPHYSICAL PROSPECTING FOR GROUND WATER IN THE PIEDMONT AREA, ALABAMA,
Alabama Geological Survey and Auburn Univ.
Thomas J. Joiner, James C. Warman, and W. Leon Scarbrough.
Geol Survey Alabama Circular 42, 1967. 48 p, 17 fig, 1 tab, 14 ref. OWRR Project B-003-Ala.

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Descriptors: *Ground water, *Groundwater geology, *Geophysics, Subsurface investigations, Explorations, Seismic investigations, Electrical resistivity, Magnetic properties, Alabama.
Identifiers: Seismic refraction, Heflin, Alabama, Piedmont.

The Piedmont is underlain by igneous and metamorphic rocks making location of ground water supplies very difficult. Ground water occurrence and movement in the Piedmont is controlled by topography, recharge and discharge, rock type, fracture systems, and type and thickness of saprolite. Approximately 12 sq mi in the Heflin area, Cleburne County, Alabama, were included in this study. Fractures within bedrock are the most effective avenues for ground water movement in this area, but domestic supplies can be produced from saprolite and alluvium overlying bedrock. Thick saprolite contributes to bedrock-fracture production by absorbing water from streams and rainfall and releasing it slowly to underlying fractures. Seismic methods were used with geologic, hydrologic, and topographic data to locate and define favorable areas for drilling. Faults or fracture systems appear to correlate with depressions on bedrock surfaces associated with thick saprolite zones. Seismic data indicate 25 prospective areas for test drilling. Resistivity data were used to confirm seismic depths to bedrock, and to locate gravelly zones in buried stream channels. Some of the buried alluvium is thick enough to be considered a potential aquifer.
W69-00654

GROUND-WATER CONTRIBUTION TO STREAMFLOW AND ITS RELATION TO BASIN CHARACTERISTICS IN MINNESOTA,
Minnesota Univ., Minneapolis.
E. A. Ackroyd, W. C. Walton, and D. L. Hills.
Minn Geol Surv Rep Invest 6, 1967. 36 p, 13 fig, 6 tab, 17 ref. OWRR Project A-009-Minn.

Descriptors: *Groundwater geology, *Groundwater, *Surface-groundwater relationships, Lakes, Forests, Wetlands, Hydrographs, Runoff, *Base flow, *Watersheds, *Minnesota, Drainage basins, *Streamflow.

Estimates of annual ground-water contribution to streamflow in 38 drainage basins of Minnesota by use of standard streamflow hydrograph separation methods permit determination of relations between ground-water runoff and such basin characteristics as geologic environment, precipitation and temperature, and percentage of lake and wetland cover. Generalized conclusions derived from analysis of the data are that ground-water runoff is: (1) least from glaciated basins that have surficial lake bed sediments or gray-drift ground moraine immediately underlain by relatively impermeable bedrock, and (2) greatest from glaciated basins that have surficial deposits immediately underlain by permeable bedrock or that have thick surficial loess deposits immediately underlain by permeable bedrock. Ground-water runoff is much greater from glaciated basins having red drift than from basins having gray drift. The rate of ground-water increases as annual precipitation increases. Lakes and wetlands sustain and regulate streamflow during rainless periods; if they were absent sustained streamflow from northern parts of the state would be greatly reduced.
W69-00660

FACTORS AFFECTING SOLUTION OF MANGANESE IN WELL WATER,
Rhode Island Univ., Kingston, Mech. Eng. and Applied Mech.
Frank J. DeLuise.
Water Resour Res Rep A-003-RI, June 1967. 11 p, 7 fig. OWRR Project A-003-RI.

Descriptors: *Manganese, *Wells, *Water, *Solubility, Water quality, Aquifers, *Groundwater, *Water wells.

This study was to determine the extent to which several factors affect the solubility of manganese in well water. Factors investigated were those which might normally or abnormally, because of pollution, be present in aquifer. The presence of carbon dioxide, organic material and microorganisms were determined to be the most significant factors. Most of the laboratory studies were conducted using manganese monoxide, manganese dioxide (most common in soils), and manganese carbonate. The study demonstrates that biological fermentation as an intracellular activity can dissolve manganese, and led to the suggestion of a manganese cycle in impoundment water.
W69-00662

NUMERICAL MODELING OF GROUND WATER FLOW,
Kansas Univ., Lawrence and Manhattan.
C. F. Weinaug, and D. W. Green.
Completion Rep, Water Resour Res Inst, Univ Kans, June 1966. 29 p, 15 fig, 3 ref, 2 append. OWRR Project A-002-Kan.

Descriptors: Groundwater, Aquifers, *Groundwater movement, Numerical analysis, Mathematical studies, Mathematical models, Computer programs, Digital computers, Groundwater recharge, Seepage, Infiltration.

A mathematical model of ground-water flow is being developed. The model basically consists of the numerical solution of the partial differential equations describing 2-phase, 2-dimensional flow in porous media, e.g., waterflow in the presence of partial air saturation. A digital computer is required in the solution technique. The mathematical model will be useful for such studies as an evaluation of methods of artificial recharge of ground-water aquifers or the determination of rate of flow between adjacent aquifers.
W69-00664

SEEPAGE FLOW THROUGH AN EARTH DAM,
Georgia Inst. of Tech., Atlanta, Civil Engineering Sch.
M. R. Carstens, and George D. May.
Water Resour Center, Ga Inst Tech, July 1966. 75 p, 21 fig, 3 tab, 11 ref. OWRR Project B-003-Ga.

Descriptors: *Groundwater movement, *Embankments, Seepage, *Earth dams, Impervious soils, Drainage systems, Isotrophy, Free surfaces, Water table, Phreatic lines, Saturation, Groundwater barriers, *Flow-nets, Two-dimensional, Homegeneity, Soil mechanics.
Identifiers: Charmonmans method, Laplaces equation, Cauchy-Riemann equation.

Charmonman's method for the numerical solution of Laplace's equation in two dimensions is described. With Charmonman's method, the solution is obtained in the complex-potential plane and is transformed back to the physical plane by use of the Cauchy-Riemann equations. The method is well suited for numerical solution of seepage problems which are bounded by streamlines and equipotential lines because the flow domain is rectangular in the complex-potential plane. Seepage flows involving a free surface are readily solved in this manner because the boundary conditions can be easily defined. The scheme is illustrated by numerical solution for seepage flow through an earth dam placed on an impervious base, having an upstream face of constant slope, and having a drainage blanket. Both the flow nets and the flow-net coordinates are presented for embankment slopes of 1 (vertical) on 1 (horizontal), 1 on 2, 1 on 3 and 1 on 4 and for three different penetrations of the drainage blanket. Comparison is made with a widely used approximation--a parabolic free surface.
W69-00665

FURTHER STUDY OF AQUIFER PERFORMANCE,
Illinois Univ., Urbana, Mining, Metall., and Petro. Eng. Dept.
Walter Rose.
Termination Rep, Water Resour Center, Univ Ill, Jan 1967. 6 p. OWRR Project A-002-Ill.

Descriptors: *Porous media, Numerical analysis, Free surfaces, Ground water, *Aquifers, *Groundwater flow.

This is a termination report of a study of performance of aquifers used for sources, storage, and conduits of water. The study resulted in the following publications: 'Reservoir Engineering Reformulated,' by Walter Rose, October 1966; 'Transport Through Interstitial Paths of Porous Solids,' Chapter 5 in Flow Through Porous Media, edited by R J M DeWiest (Academic Press, 1967, by W Rose); Ph D thesis of H D Fara titled 'On the Geometry of Porous Media' February 1967, University of Illinois; and Ph D thesis of Balbir Singh, 'Numerical Study of Time-dependent Free Surface Flow.'
W69-00674

NOTES ON THE GEOHYDROLOGY OF THE DAKOTA SANDSTONE, EASTERN NORTH DAKOTA,
U. S. Geological Survey, Grand Forks, North Dakota.
T. E. Kelly.
U S Geol Surv Prof Pap 600-C, pp C185-C191, 1968. 7 p, 3 fig, 17 ref.

Descriptors: *Hydrogeology, *Sandstones, *Aquifers, *North Dakota, Transmissivity, Permeability, Water quality, Water yield, Artesian wells.
Identifiers: *Dakota sandstone.

In eastern North Dakota the Dakota Sandstone consists primarily of unconsolidated fine sand. Transmissibilities are less than 50,000 gals per ft, and the coefficient of storage is about 0.0004. Total dissolved solids and fluoride content differ considerably from place to place; the silica concentration is lower than in water from the glacial drift. Maps show configuration of the top of the Dakota Sandstone, total dissolved solids concentration of water from the uppermost producing sands. The water quality data suggest that a major source of recharge is upward leakage from the underlying Red River Formation. (Knapp-USGS)
W69-00680

RELATION BETWEEN AQUIFER CONSTANTS AND ESTIMATED STRESS ON AN ARTESIAN AQUIFER IN EASTERN MONTANA,
U. S. Geological Survey, Denver, Colorado.
O. James Taylor.
U S Geol Surv Prof Pap 600-C, pp C192-C195, 1968. 4 p, 5 fig, 9 ref.

Descriptors: *Aquifers, *Confined water, *Stress, *Strain, Overburden, Compressibility, Permeability, Porosity, Potentiometric level, Storage coefficient, Montana.
Identifiers: *Aquifer constants, Fox Hills-Basal Hell Creek aquifer.

Studies show that the Fox Hills-basal Hell Creek artesian aquifer in eastern Montana is subjected to different vertical stress related to differences in the weight of the overburden, which is partly supported by the artesian pressure at the top of the aquifer. Aquifer tests indicate values of the coefficient of permeability which appear to correlate with the estimated vertical stress on the aquifer at the aquifer-test sites. The coefficients of storage also changes with the estimated vertical stress on the aquifer, according to data from sonic logs and theoretical studies. Accordingly, the coefficients of permeability and storage of the aquifer vary in space and may change during aquifer development. Graphs and diagrams show vertical stress and the

relation between permeability and stress on the aquifer skeleton. (Knapp-USGS)
W69-00681

SUMMARY OF GROUND-WATER HYDROLOGIC DATA IN MICHIGAN IN 1967,
U S Geological Survey, Lansing, Mich, Water Resources Division.
P. R. Giroux, and G. C. Huffman.
Michigan Dep of Conserv, unnumbered Bull, 108 p, 1968. 39 fig, 5 tab, 86 ref.

Descriptors: *Data collections, *Hydrologic data, *Water levels, *Water yield, *Water quality, Hydrographs, Water wells, Water level fluctuations, Michigan.
Identifiers: Periodic observations.

Records of groundwater levels in the principal aquifers, records of pumpage, summaries of public water supply facilities, and the effects of precipitation on groundwater levels are compiled for Michigan through 1967. Records of water levels in areas of heavy pumpage and in areas where changes are principally from natural influences are illustrated or tabulated to allow comparison between these types of water-level fluctuations. The water-levels and related data provide a day-to-day record for the evaluation of available groundwater supplies. The long-term records serve as a framework to which short-term records may be related. Observation well records include water levels, well location, depth, elevation, aquifer, and extremes of water level in the past record and in 1967. Pumpage by most major water users in 1967 is tabulated. Hydrographs are used to illustrate water level changes. Well yield, pumpage, storage facilities, treatment, quality of water, per capita use and trends of water levels are summarized. (Knapp-USGS)
W69-00698

LABORATORY EVALUATION OF SELECTED RADIOISOTOPES AS GROUND-WATER TRACERS,
Texas A and M University, College Station, Texas.
A. Ray Jennings, and Melvin C. Schroeder.
Water Resources Res, Vol 4, No 4, pp 829-838, Aug 1968. 10 p, 2 fig, 3 tab, 16 ref.

Descriptors: *Tracers, *Radioisotopes, *Groundwater, Movement, Velocity, Distribution pattern, *Ion exchange, Adsorption.
Identifiers: *Groundwater tracers, Radioactivity.

Tracer appearance results from movement along the most direct flow path, and thus arrival of the maximum concentration is the best index for determining average water velocity. Antimony 121, cerium 141, chromium 51, indium 114, ruthenium 103, and strontium 85 in chelate form were tested, as the unchelated ions are subject to greater delay by adsorption and ion exchange. Distribution-coefficient measurements were made under static conditions for crushed illitic shale and limestone. These measurements can be used to predict the elution history of a tracer from an exchange column. Comparisons of the predictions, the tracer elution histories, and elution histories for chloride pulses indicate that chelated chromium 51 is an adequate groundwater tracer. Average velocity of groundwater is equal to the sum of the tracer velocity plus the product of the tracer velocity, the distribution coefficient, and the bulk density of the aquifer divided by its effective porosity. The distribution coefficient for an ideal tracer is zero; the average velocity of this tracer is equal to the average groundwater velocity. (Knapp-USGS)
W69-00701

2G. Water in Soils

SEASONAL MOVEMENT OF PERCOLATING WATERS TO THE GROUND WATER TABLE UNDER HARDWOOD FORESTS IN MICHIGAN,
Michigan State Univ, East Lansing.
Donald P. White.
Term Rep, Dep Forest, Mich State Univ, June 1967. 51 p, 7 fig, 9 tab, 5 ref, append. OWRR Project A-006-Mich.

Descriptors: Hydrologic cycle, *Ground water, Artesian water, Soil moisture, Aquifers, Observation wells, *Water table, *Deep percolation, Precipitation (Atmospheric), Seepage, Field capacity, Michigan, Wells, Forest soils.
Identifiers: Piezometric surface, Soil water storage.

Hydrologic and geologic investigations of ground water at two forested sites in south-central Michigan indicated that direct measurement of recharge to the ground water table by recording wells was greatly confounded by artesian aquifers and uncontrollable regional hydrologic effects. A soil moisture budget for a period of subnormal precipitation, 1961 and 1967, was determined and ground water recharge estimated at one of the study sites. The annual cyclic pattern is similar for each year, but varies in magnitude of fluctuations dependent upon quantity and distribution of precipitation. Precipitation during the study period was 68% of normal. Infiltration of precipitation during growing season normally does not penetrate to depths greater than 3 ft. Depletion occurs at all depths within the measured 9-ft profile but not at equal rates. Changes in total soil moisture storage are partitioned into recharge, evapotranspiration, and deep seepage losses. The deep seepage component is estimated from the total soil moisture depletion curve and from assumed evapotranspiration rates. Deep seepage losses account for 1.31 in. of precipitation available as ground-water recharge during the growing season.
W69-00420

AN ANALYSIS OF THE VERTICAL INFILTRATION OF WATER INTO SOIL COLUMNS,
Arizona Univ., Tucson.
John L. Thames, and D. D. Evans.
Water Resources Res, Vol 4, No 4, pp 817-828, Aug 1968. 12 p, 10 fig, 4 tab, 8 ref.

Descriptors: *Infiltration, *Soil, *Porous media, *Soil density, Regression analysis, Flow characteristics.
Identifiers: *Flux equations, Vertical water infiltrations.

To investigate the behavior of soil water movement during infiltration and thereby determine the applicability of flux equations involving soil water content gradients as the apparent driving force, an experimental study was made of vertical infiltration of water. Sandy-loam and silt-loam soil materials were used as experimental media. Water was allowed to enter air-dry columns of soil at a small constant suction, and the subsequent distribution was followed with a gamma radiation attenuation device. An analytical expression of water content as a function of depth and time was obtained by multiple regression analysis, from which it was possible to determine the instantaneous flux and the water concentration gradient at given water contents. Nonlinearity at low water gradient was evidenced for both soils throughout a wide range of water contents; the magnitude and direction of departure from linearity were similar for both soils. A new empirical flow equation was obtained by modifying the diffusivity equation for unsaturated flow. Under this modification, derived by raising the water-content gradient to a power greater than unity, the parameter analogous to soil-water diffusivity becomes a function of both water content and water-content gradient. (Llaverias-USGS)
W69-00443

FLOW AROUND A VERTICAL SHEETPILE EMBEDDED IN AN INCLINED STRATIFIED MEDIUM,
Northwestern Univ, Evanston, Ill.
For primary bibliographic entry see Field 08D.
For abstract, see .
W69-00584

A NUMERICAL METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE AND EVAPORATION OF WATER FROM SOIL,
Agricultural Research Service, Fort Collins, Colo; University of Illinois, Urbana.
R. J. Hanks, and A. Klute.
Pap 68-214, Amer Soc Agr Eng 1968 Annu Meet, Logan, Utah, June 1968. 16 p, 7 fig, 1 tab, 8 ref.

Descriptors: *Numerical method, *Infiltration, Drainage, *Evaporation, Moisture content, Soils, *Soil moisture, Computer programming, Boundary values, Hysteresis, Water table, Diffusion, Soil science, Wetting and drying tests.
Identifiers: Soil columns, Soil moisture movement, One-dimensional, *Soil-water relationship, Potential evaporation, Conductivity.

A numerical method was developed for estimating one-dimensional infiltration of water into soil where water added by precipitation at the surface was equal to or greater than the infiltration rate. The method estimated redistribution of water within the soil after precipitation had stopped, taking into account hysteresis in the water content-pressure relation. Drainage into a water table was considered. The method allowed for evaporation at a rate determined by external climatic conditions or at a rate determined by internal soil conditions. Graphs are given of: (1) water content-pressure relations; (2) cumulative flow-time relations and water content profiles for an infiltration, redistribution, evaporation problem; (3) water content profiles after redistribution, using wetting and drying curves with and without hysteresis; and (4) cumulative flow, water content profiles, and pressure profiles for a drainage-evaporation problem. (USBR)
W69-00589

EXPERIMENTAL EVALUATION OF INFILTRATION EQUATIONS,
Purdue Univ, Lafayette, Ind.
R. W. Skaggs, L. F. Huggins, and E. J. Monke.
Pap 68-213, Amer Soc Agr Eng 1968 Annu Meet, Logan, Utah, June 1968. 26 p, 6 fig, 3 tab, 18 ref.

Descriptors: *Infiltration, *Experimental data, Analysis, Soils, Time, Soil erosion, Surface runoff, Bibliographies, Erosion, Field tests, Soil moisture, Soil physical properties, Runoff, Soil science, Agriculture, Hydrology.
Identifiers: Evaluation, Rainfall-runoff relation, *Infiltration rate, Equations, Rainfall simulators, Wetting front, Regression analysis.

An analysis of infiltration equations proposed by Green and Ampt, Hortan, Phillip, and Holtan was made using experimental data obtained in erosion studies with a plot-size rainfall simulator. An overland flow analysis was used to determine the infiltration rate-time relationship from the runoff hydrograph. Regression fits of the 4 equations to experimental data for 52 tests on 13 soils showed that all of the equations adequately described the infiltration rate-time relationship. Values of the equation parameters for each run analyzed are presented in the paper. (USBR)
W69-00600

SALT-WATER INTRUSION EFFECT OF A FRESH-WATER CANAL,
Georgia Inst. of Tech., Atlanta, Civil Eng. Sch.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-00667

GRAVIMETRIC PRESSURE CELL INVESTIGATION OF HYSTERESIS AND HYDRAULIC CONDUCTIVITIES IN SOILS,
Ministry of Agriculture, Cambridge, England and Michigan State University, Ann Arbor.
E. U. Nwa, R. J. Kunze, and E. H. Kidder.
Quart Bull of Mich Agr Exp Sta, Vol 50, No 4, pp 559-569, May 1968. 11 p, 10 fig, 2 tab, 17 ref.

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Descriptors: *Hydraulic conductivity, *Soils, *Soil moisture, *Hysteresis, Percolation, Laboratory tests, Methodology.
Identifiers: *Gravimetric pressure cell, Sandy loam.

The moisture content-pressure relationships of 5 samples of Hillsdale sandy loam and Sim's loam soils were measured, and the reproducibility of hysteresis loops was tested by using the same pressure steps for each absorption-desorption cycle. In each sample the total volume of water expelled during desorption was greater than the total volume taken in during absorption in the first run. This was caused by the smaller volume of air trapped in initial saturation; on 3 samples in subsequent runs the absorbed and desorbed moisture were equal because entrapped air remained constant. The 2 samples with high organic content absorbed more and more water in subsequent runs. It was not possible to reproduce the moisture content-suction curves. It is concluded that the history and experimental conditions must be specified when reporting the characteristic parameters for soils, and the assumption of a unique relationship between the calculated hydraulic conductivity and the moisture content was not valid for these data. (Knapp-USGS)
W69-00703

2H. Lakes

CHEMICAL QUALITY OF SURFACE WATERS IN DEVILS LAKE BASIN NORTH DAKOTA, 1952-60,
U S Geological Survey, Water Resources Division.
High T. Mitten, C. H. Scott, and Philip G. Rosene.

U S Geol Surv Water-Supply Pap 1859-B, pp B1-B42, 1968. 41 p, 9 fig, 1 plate, 11 tab, 14 ref.

Descriptors: *Water quality, *Surface waters, *Saline lakes, Salts, Chemical precipitation, North Dakota, Reclamation, Recreation demand, Data collections.
Identifiers: Devils Lake Basin, North Dakota.

The quality of water in the Devils Lake Basin, North Dakota, was studied between 1952 and 1960 to add data to earlier collections and to describe in better detail factors affecting the water quality of the area, as part of a tentative water quality and lake-level restoration plan. Lake levels have generally declined by evaporation since about 1800 and concentrations of dissolved salts reached 8,680 ppm in Devils Lake and 127,000 ppm in eastern Stump Lake. Above average rainfall raised lake levels in 1954, 1956, and 1957 to the highest levels in forty years. Concentration of salts decreased to 6,000 ppm in Devils Lake. The major dissolved constituents in the lake waters of the basin are sodium and sulfate. Salt balance computations indicate that as much as 35,000 tons of salts precipitated from Devils Lake in dry years, and in some wet years 89,000 tons were redissolved. Between 1952 and 1960, 201,000 tons were deposited on the bed of East Devils Lake, 15,100 tons in Stump Lake, and 421,000 tons in eastern Stump Lake. It is estimated that not more than 20% of the total amount deposited in the lowering of the lakes will redissolve if lake levels are raised. (Knapp-USGS)
W69-00424

PLANKTONIC PHOTOSYNTHESIS AND THE ENVIRONMENT OF CALCIUM CARBONATE DEPOSITION IN LAKES,
Minnesota Univ., Minneapolis, Limnological Res Center.
Robert O. Megard.
Interim Rep 2, Univ Minnesota, Jan 1968. 47 p, 7 fig, 6 tab, 33 ref. OWRR Proj A-008-Minn.

Descriptors: *Photosynthesis, *Calcium carbonate, Aquatic environment, Aquatic productivity, Eutrophication, *Lakes, Limnology, *Plankton, Algae, Bibliographies, Chemical precipitation, Ions, Biochemical oxygen demand, Minnesota, Water chemistry, Biodegradation.

Calcium and alkalinity concentrations increase in a productive lake during winter and the water at all depths becomes undersaturated with calcium carbonate. Soon after ice melt, the entire water column becomes oversaturated with calcium carbonate, and calcium and alkalinity concentrations decrease during spring, summer, and autumn. When the lake becomes thermally stratified, carbonate oversaturation increases at depths in which photosynthesis occurs, but the water at greater depths becomes undersaturated. Carbonate saturation appears controlled by the balance between carbon dioxide assimilation by planktonic photosynthesis and carbon dioxide release by respiration. Seasonal changes of calcium concentrations are balanced by chemically equivalent alkalinity changes, but magnesium concentrations do not fluctuate. Photosynthesis occurs in both the epilimnion and the metalimnion of a deeper, less productive lake. These are the only depths oversaturated with calcium carbonate during open-water season.
W69-00446

LIMNOLOGY, PRIMARY PRODUCTIVITY, AND CARBONATE SEDIMENTATION OF MINNESOTA LAKES,
Minnesota Univ.
Robert O. Megard.
Limnological Res Center, Interim Rep 1, Jan 1967. 69 p, 25 fig, 11 tab, 7 ref. OWRR Project A-008-Minn.

Descriptors: Sedimentation rates, *Eutrophication, *Lakes, *Primary productivity, *Plankton, Algae, *Photosynthesis, Productivity, Water quality, *Limnology, Minnesota, Water analysis, Calcium carbonate, Hypolimnion.

The report describes investigations of the regional limnology of Minn. The work has involved 3 phases: (1) a mobile laboratory was designed and outfitted; (2) standard field and laboratory methods were modified to make them more compatible with the mobility of the laboratory; and (3) a study was begun of the primary productivity and general limnology of 14 lakes in various parts of the state. The laboratory permits water samples to be analyzed at lakeside before nutrient concentrations are altered by biological activity and provides facilities for measuring the growth rates of algae and determining the fertility of lake water. The oxygen light-dark-bottle method is being used to compare algal productivity. The response of the carbonate saturometer in fresh water was tested, and the instrument was used to determine the degree of calcium carbonate saturation at different times of the year and at various depths in the lakes. The seasonal chemical changes in the lakes are described and the productivity data assembled, but there are not yet enough data for a detailed comparison of the lakes.
W69-00632

SURFACE-WATER CHEMISTRY OF SOME MINNESOTA LAKES, WITH PRELIMINARY NOTES ON DIATOMS,
Minnesota Univ., Minneapolis.
Robert C. Bright.
Limnological Res Center, Bell Museum Natur History, Univ Minn Interim Rep 3, Apr 1968. 51 fig, 44 ref, append, disc. OWRR Project B-001-Minn.

Descriptors: Bibliographies, *Minnesota, *Lakes, *Diatoms, *Algae, Ecology, South Dakota, Field investigations, Water pollution, Water sampling, *Water analysis, *Chemical analysis, pH, Sampling, On-site data collections, Limnology.

A comprehensive field study was made of diatom ecology in lakes of Minn and adjacent parts of South Dakota. The program consisted of 4 phases: (1) identification and determination of the geographic distribution and relative abundance of diatoms in the region, (2) correlation of diatom distribution and relative abundance with regional patterns of surface-water chemistry, (3) correlation of information from the first 2 phases with the composition of the diatom flora in surface sediments from each lake, and (4) application of conclusions from the first three parts to fossil diatom floras and paleoecology of lakes. Minnesota and adjacent South Dakota comprise the best area in North America for such a broad study because of the wide variety of lake types and their wide range of salinity. The ensuing discussions deal mainly with fall surface-water chemistry, possible origins of its regional pattern, its correlation with similar data from other areas, and its controlling factors.
W69-00659

2I. Water in Plants

GROUND WATER REGULATION IN THE COASTAL FLATWOODS OF MISSISSIPPI,
Mississippi State Univ., State College.
W. Frank Miller.
Water Resour Res Inst Rept July 1966. 10 p, 4 tab, 22 ref, disc. OWRR Project A-005-Miss.

Descriptors: *Groundwater, *Water management, *Mississippi, Coasts, Soil moisture, *Drainage, Pine trees, *Trees.
Identifiers: *Groundwater management.

This study was designed for evaluating water balance relationships of poorly drained Coastal Flatwoods soils and determining the feasibility of water regulation to increase production of slash pine (Pinus elliotti). These extensive, poorly drained areas which once supported longleaf pine (P. palustris), are now, through cutting practice and the advent of fire protection, primarily slash pine sites. Preliminary observations in the Flatwoods indicated that in addition to an excess of ground water during the initial portion of the growing season, there was a possibility of drought conditions which might limit the growth rate of the pine in the late spring and again in the late fall. The conclusion was reached that water table regulation of the studied soils is desirable.
W69-00635

THE WATER ECONOMY OF TURFGRASS,
Rhode Island Univ., Kingston, Coll of Agri.
Irene H. Stuckey.
Termination Rep, Coll Agr, Univ Rhode Island, 1967. 17 p, 14 fig. OWRR Project A-009-RI.

Descriptors: *Turf grasses, Grasses, Bluegrasses, Kentucky bluegrass, Turf, Field capacity, Soil moisture, Agriculture, Plant physiology, Irrigation effects, Moisture content, *Water requirements.

Replicated plots of Kentucky bluegrass were clipped at 3/4, 1-1/2, and 3 in. Soil moisture was measured by plaster of Paris blocks at 3 in. and at 8 in. Block 1 covered with an automatic rain shelter received 1 in. of water whenever the 3 in. level in the soil dropped below 50% in half of the plots. Block 2 received rain and additional irrigation on the same basis as Block 1. Block 3 received only rain. Less water was used by the 3/4 in. cut, but these plots were weedy and unattractive and subject to erosion. Moisture from lower levels influenced readings at the 3 in. depth since they would change abruptly when the moisture level at the 8 in. level changed.
W69-00663

2J. Erosion and Sedimentation

POLLEN AND DIATOMS IN SEDIMENTS OF A POST-PLEISTOCENE LAKE,
Iowa State Univ. of Science and Technology, Ames, Dep Bot Plant Pathol.
John D. Dodd, Ruth M. Webster, and Larry Wehr.

Proj Rep, Iowa State Univ Sci and Technol, Ja 1967. 9 p. OWRR Project A-008-Ia.

Descriptors: Cores, Glacial soils, Till, Carbon radioisotopes, Lake soils, *Diatoms, *Pollen, Palynology, Sediments, Marine microorganisms, *Lake beds, Aquatic animals.
Identifiers: Lake Okoboji, Iowa.

Preliminary analyses were made of a 35-ft core sample from post-glacial sediments in Miller's Bay, Lake Okboji, Iowa. A radiocarbon date of 12,700 plus or minus 200 yr for the bottom level was obtained. Comparative evaluations of diatoms and pollen have been initiated, the latter suggesting the expected transition from gymnosperm forest to mixed forest to prairie. Redeposited foraminifera, radiolarians, and coccoliths of Cretaceous origin were noted. In addition to pollen and diatoms, numerous plant and animal fragments were encountered in the sediments. These included Staurastrum (desmid), Rivularia (blue-green alga), Pediastrum (green alga), Chara zygotes, chrysophyte cysts, moss leaves, grass epidermis, bladderwort leaf hairs, insect larval mouth parts, cladoceran fragments, sponge spicules, bryozoan cysts, ostracod valves, snail shells, etc. Analyses of organic content suggested that wide fluctuations in this parameter were related to periods of environmental change.
W69-00404

EROSION FROM SUBURBAN HIGHWAY CONSTRUCTION,
U S Geological Survey.
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00423

DADE COUNTY, FLORIDA (BEACH EROSION CONTROL AND HURRICANE PROTECTION).
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 335, 103 p, 1968. 16 fig, 1 plate, 9 tab, 1 suppl, 1 append.

Descriptors: *Beach erosion, *Shore protection, *Flood control, *Landfills, Hurricanes, Coastal engineering, Florida, Wave pile-up, Currents (Water).
Identifiers: Dade County, Florida, Miami Beach.

A beach erosion and hurricane protection study in Dade County, Florida, found that the most practical way to restore adequate recreational and protective beaches and to stabilize the shoreline is to artificially fill the beach and dunes between Government Cut and Baker's Haulover, and build a beach at Haulover Beach Park. The plan of improvement would involve placement of about 14, 800,000 cubic yards of fill. Periodic replenishment is necessary. Estimated first cost is $29,500,000 and annual cost is $488,000. Hurricane frequency, hurricane tide data, flood damage, and costs are tabulated. Maps show plan of improvement, hurricane paths, tides and high water profiles. (Knapp-USGS)
W69-00441

EROSION OF COHESIVE SEDIMENTS,
Bureau of Reclamation, Denver, Colo.
Phillip F. Enger, Ernest T. Smerdon, and Frank D. Masch.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY4, pp 1017-1049, July 1968. 33 p, 21 fig, 6 tab, 64 ref, append.

Descriptors: Agriculture, Channels, *Cohesive soils, Design criteria, *Erosion, Field investigations, Hydraulic laboratories, Sedimentation, Hydraulics, Sediment control, *Sediments, Bibliographies, *Soil erosion, Deposition, Soil physical properties, Tractive forces, Boundary shear, Scour, Stable channels.
Identifiers: Sediment load, Sediment deposits, Bank stability, Critical tractive force.

This final report describes laboratory research, field observations, design criteria, and agricultural land and channel problems relating to cohesive sediments. Laboratory research has been directed toward determining relationships between a critical boundary shear stress or a tractive force above which scour of a cohesive material begins, pertinent soil properties, and flow conditions. Erosion or deposition occurring in a natural water channel depends on the local forces exerted by flowing water, geology and properties of the material over which the water flows, and sediment load being transported. Current literature is reviewed and recommendations are made for practical design application and future research. An extensive bibliography, a compilation of design equations and charts, and design information not available in the literature are included. (USBR)
W69-00608

VELOCITY AND SEDIMENT CONCENTRATION DISTRIBUTIONS IN OPEN CHANNEL FLOWS,
South Dakota State Univ., Brookings.
B. E. Eno.
Report to OWRR Project A-007-SDak, June 1968. 7 p.

Descriptors: *Open channel flow, Flow characteristics, Flow profiles, *Velocity, Transition flow, Turbulent flow, Theoretical analysis, Sediment transport, *Sediment distribution, Instrumentation, Continuity equation, Momentum equation, *Channel morphology, Boundary layer, Roughness coefficient.

Turbulent velocity distributions in open channel flows were analytically reviewed and experimentally investigated. The works of Prandtl, Von Karman, and Nikuradse pertaining to turbulent velocity distributions were critically reviewed with a view toward particular application to open channel flows. Physical and mathematical inadequacies of these works were noted and discussed. The experimental phase consisted of velocity distribution measurement in smooth and artificially rough channels. The roughness elements included lateral strips, cubes and hemispheres placed on the flume bed at various spacings in various patterns. An equivalent roughness parameter was devised and calculated for many of the roughness patterns. The experimental results were compared to the work of other authors and discussed. The suspended sediment transport theory was briefly reviewed, emphasizing its dependency upon a valid velocity distribution model.
W69-00675

GENERAL TWO-DIMENSIONAL STOCHASTIC MODEL FOR THE TRANSPORT AND DISPERSION OF BED-MATERIAL SEDIMENT PARTICLES,
U. S. Geological Survey, Colorado State University, Fort Collins, and Kansas State University, Manhattan.
William W. Sayre, and W. Jay Conover.
Proc of the 12th Congr, Int Ass for Hydraul Res, pp 88-95, Sept 1967. 8 p, 2 fig, 6 ref.

Descriptors: *Bed load, *Dispersion, *Sediment transport, *Statistical models, *Stochastic processes, Alluvial channels, Tracking techniques, Marking techniques, Sediments.
Identifiers: *Stochastic models.

The transport of bed-material sediment particles in an alluvial channel is represented as a stochastic process consisting of a sequence of longitudinal and vertical displacements of random magnitude between which there are rest periods of random duration. In order to apply the model, the probability density functions for (1) the step lengths, (2) the rest period durations given the elevation at which a particle is deposited, and (3) the elevation at which a particle is deposited, must be known. It is suggested that these functions be experimentally evaluated by tracing a single radioactive particle to evaluate length of steps and rest periods. (Knapp-USGS)
W69-00683

TOTAL BED-MATERIAL DISCHARGE IN ALLUVIAL CHANNELS,
Geological Survey, Washington, D. C., Water Resources Div., Colorado State University, Fort Collins.
Feng-Ming Chang, Daryl B. Simons, and Everett V. Richardson.
Proc of the 12th Congr, Int Ass for Hydraul Res, pp 132-139, Sept 1967. 8 p, 2 fig, 6 ref.

Descriptors: *Sediment transport, *Bed load, *Suspended load, *Alluvial channels, Flow rates, Particle size.
Identifiers: Prandtl equation, Reynolds equation, Bed-material discharge.

A study of total bed-material discharge in alluvial channels, partially based on existing theories, was conducted. The bedload discharge was obtained by utilizing the energy-work relation of the fluid and the bed material. An equation for velocity distribution was obtained by integrating the Reynolds equations using Prandtl's hypothesis of mixing length. Applying the basic equation for the distribution of suspended load by O'Brien, the suspended bed-material discharge was investigated in terms of bedload discharge. Then, the total bed-material discharge was obtained simply by adding the bedload discharge and the suspended bed-material discharge. The results through checking with available laboratory and field data appeared to be mutually consistent and satisfactory. (Knapp-USGS)
W69-00684

EFFECT OF NON-EQUILIBRIUM FLOW CONDITIONS ON SEDIMENT TRANSPORT AND BED ROUGHNESS IN A LABORATORY ALLUVIAL CHANNEL,
U S Geological Survey, Colorado State University, Fort Collins.
R. E. Rathbun, and H. P. Guy.
Proc of 12th Congr, Int Ass for Hydraul Res, pp 187-193, Sept 1967. 7 p, 2 fig, 4 ref.

Descriptors: *Sediment transport, *Flumes, *Sediment load, *Graded, *Model studies.
Identifiers: Nonequilibrium flume flow conditions.

Non-equilibrium flow conditions were examined in a laboratory alluvial channel to determine responses of the recirculation and sand-feed systems of flume operation to change in load, tailwater depth, and sand-bed slope. It was found that the simple proportionality suggested by Lane (1955) for relating sediment transport rate, sand size, water discharge and slope, predicted qualitatively the results. Experiments were limited to one water discharge and one sand. (Author)
W69-00685

2K. Chemical Processes

CO-OXIDATION OF ORGANIC MOLECULES BY METHANE-OXIDIZING BACTERIA GROWING AT THE EXPENSE OF METHANE,
Illinois Univ, Urbana.
R. E. Kalio.
Water Resour Center Res Rep 11, Univ Ill, July 1967. 5 p, 1 fig, 1 tab. OWRR Project A-016-Ill.

Descriptors: *Bacteria, *Methane, Benzenes, Aromatic compounds, *Oxidation, Enzymes, Methane bacteria, Pseudomonas.

Bacteria which oxidize methane are known to oxidize other substances while they are growing on methane. Tests were conducted on a large number of these bacteria to determine whether they could oxidize benzene-based organic compounds. None of the methane-oxidizing bacteria attacked benzene rings. Bacteria which attack benzene (or aromatic) rings contain an unusual enzyme called benzene hydroxylase which is not found in methane-oxidizing bacteria.
W69-00407

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THERMODYNAMIC RELATIONSHIPS WITHIN THE SYSTEM: SEDIMENTS-SEA-AIR,
Massachusetts Univ, Amherst.
Oliver T. Zajicek.
OWRR Project A-012-Mass, Final Rep, Jan 1968. 11 p, 7 fig.

Descriptors: *Iron oxides, *Equilibrium, Chemical reactions, Vapor pressure, *Oxygen, Sea water, Atmosphere, pH, Electrochemistry, Solutions, Solubility, Aqueous solutions, Electrical conductance, Thermodynamics, Thermodynamic behavior.

This project attempts to add to our knowledge of a chemical equilibrium thought to obtain at the hydrosphere-atmosphere interface, namely, the interaction of iron oxides with molecular oxygen, thought possible to be the buffering equilibrium for the oxygen content of the atmosphere. The question arises as to whether the partial pressure of oxygen is still increasing or whether it is fixed at its present value of 0.21-atm. Conductivity and pH measurements have been carried out on solutions of ferric nitrate in chloride-nitrate mixed media. The pH range, electrolyte concentration, and composition of salt media have been varied. Eleven solvent solutions were used in which the ionic mole ratio was varied from 0 to 1. In these solutions the total electrolyte concentration was held constant at 0.5, 1.5, 2.5, and 3.5 mole/1. Because of the termination of the project, results to date are incomplete and positive conclusions cannot be drawn from the data. However, certain anomalous trends were observed in which conductivity increased while pH decreased, suggesting the possibility of a polymeric hydrolyzed iron species in which the adsorbed hydrogen ions are thermodynamically stable yet kinetically liable.
W69-00415

ISOTOPIC ANALYSIS OF URANIUM IN NATURAL WATERS BY ALPHA SPECTROMETRY,
U S Geological Survey, Water Resources Division.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-00425

FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-II. INFLUENCE OF HYDRONIUM ION CONCENTRATION ON ABSORPTIVITY,
Rutgers Univ., New Brunswick, N. J.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-00622

2L. Estuaries

THE NET EFFECT OF WIND ON TIDAL STREAMS IN FLORIDA,
Florida Univ, Gainesville.
David H. Moreau.
Water Resour Res Proj Completion Rep, Oct 1967. 11 p, 1 fig, 5 tab, 5 ref. OWRR Project A-006-Fla.

Descriptors: *Wind tides, *Winds, Wind velocity, Waves, Regression analysis, Estuaries, Florida, Time series analysis, *Tides.

The object of this study was to determine the effect of wind velocities on tide heights in a small Floridian estuary. In particular, the task was to perform a statistical analysis of wind and tide data collected during a one-year period at Cedar Key, Florida. Astronomical tides were extracted from the data using a harmonic function for the nine most significant components from a total of twenty-six as reported by USC and GS. Coefficients were estimated using a least-squares analysis. Astronomical tides accounted for 87% variance in the record. Hourly deviations of observed data from estimated astronomical tides averaged-0.027 feet with a standard deviation of 0.705 feet. Those deviations were then related to components of wind velocity taken perpendicular and parellel to the shore line using linear regression analysis. Averaging of the instantaneous wind velocities at a given hour with those in the preceding hour produced the best correlations, but this combination explained only 25% of the residual variance. Several factors were noted that limited the correlation: (1) data were available at a single station, (2) all data were instantaneous readings, and (3) the analysis was based on all wind observations with no attempt to select only those data corresponding to higher winds.
W69-00409

PROCEEDINGS SYMPOSIUM ON ESTUARINE ECOLOGY COASTAL WATERS OF NORTH CAROLINA.
North Carolina Univ., Chapel Hill, Water Resour. Res. Inst.

May 1966. 111 p, 1 fig, 9 tab, 17 ref. OWRR Proj A-999-NC.

Descriptors: *Estuaries, *Estuarine environment, *Estuarine fisheries, *Ecology, *Ecosystems, State governments, Federal Government, North Carolina.

This Proceedings of a Symposium on Estuarine Ecology of the Coastal Waters of North Carolina includes papers describing the estuarine research and action programs of the N. C. Departments of Conservation and Development, Water and Air Resources, and Health; N. C. Wildlife Resources Commission and State Recreation Commission; and the U. S. Fish and Wildlife Service, National Park Service, Public Health Service; the University of North Carolina at Chapel Hill and North Carolina State University at Raleigh.
W69-00460

DYNAMIC AND STATIC STUDIES OF SEA-WATER INTRUSION,
Hawaii Univ., Honolulu.
L. Stephen Lau.
Water Resour Res Center, Univ Hawaii, Tech Rep No 3, Feb 1967. 31 p, 9 fig, 20 ref, 4 append. OWRR Project A-007-Hi.

Descriptors: Saline water intrusion, Hawaii, Ground water, Basalts, Aquifers, Density stratification, Ground water, Saline water-freshwater interfaces.
Identifiers: Ground water discharge, Density diffusion, Ground water dispersion, Ghyben-Herzberg principle.

A theoretical equation was adapted and modified for a water table aquifer to relate fresh water flow to the sea, geometry of the fresh water-sea water interface, and aquifer characteristics under dynamic equilibrium. Verification was obtained in laboratory experiments conducted in a hydraulic sand model. Other laboratory experiments revealed special flow patterns in the transitional zone of the fresh water-sea water interface. The extent and the vertical density gradient of the brackish water in the transitional zone were examined for their effects on modifying the conventional Ghyben-Herzberg ratio. Groundwater data collected from a deep well on Oahu, Hawaii, was discussed as an illustration.
W69-00618

SALT-WATER INTRUSION EFFECT OF A FRESH-WATER CANAL,
Georgia Inst. of Tech., Atlanta, Civil Eng. Sch.
M. R. Carstens, and George D. May.
Water Resour Center, Ga Inst Tech, May 1967. 49 p, 6 fig, 6 tab, 5 ref, 1 append. OWRR Project B-003-Ga.

Descriptors: *Aquifers, *Seepage, Flow, *Groundwater movement, Soil water movement, Canals, *Saline-fresh water interfaces, *Groundwater barriers, *Saline water intrusion, Permeability, Water table, Flood plains, Pore pressure, Land reclamation, Flownets, Silts, Saturated flow, Saturated soils, Subsurface flow, Laplaces equation.
Identifiers: Chauchy-Riemann equation.

The effectiveness of a fresh-water canal to act as a barrier to salt-water intrusion in areas adjacent to salt-water bodies is analyzed and discussed. Results for a condition in which the fresh-water seepage from the land is a small fraction of the fresh-water seepage from the canal are presented. Solutions discussed show that the fresh-water flow from a canal acts as a dam forcing to a lower elevation the interface between the salt-water saturated soil and the fresh-water saturated soil. Laplace's equation in the fresh-water flow domain is solved for the flow condition which involves a water table and a second density interface between the fresh water and salt water. Seepage losses from a fresh-water canal with fine-grained soils were not found to be excessive. Use of a fresh-water canal for reclamation of salt-water intruded deltas for agricultural purposes are discussed.
W69-00667

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

YIELD OF STREAMS IN MASSACHUSETTS,
Massachusetts Univ, Amherst.
G. R. Higgins.
OWRR Project A-003-Mass, Water Resour Res Center, Univ Massachusetts, Interim Rep, Mar 1967. 175 p, 14 fig, 4 tab, 13 ref, 4 append.

Descriptors: *Water yield, *Storage, *Hydrology, Mass curves, *Streams, Frequency, Flow, Evaporation, Droughts, Drainage basins, Massachusetts.

It is specifically the purpose of this project to provide a practical guide whereby preliminary values of storage required to sustain a desired yield from any drainage basin in the Commonwealth of Massachusetts can be easily predicted. Mass curves, recurrence interval curves, and flow duration curves for nearly all the gaged streams in Massachusetts are presented together with a discussion of the water resource problems of the Commonwealth. Results from the mass curves are expressed in the form of frequency curves which reflect all the streamflow data available through the drought year of 1965. In order to estimate the effect of creation of reservoirs on yield, the current research efforts are concerned with an evaporation study on the Quabbin Reservoir. In subsequent reports it is recommended that these data be incorporated along with a full assessment of the drought. The present report is labeled INTERIM pending the further study and application of computer methods to working up the data.
W69-00411

SMALL WATERSHED STORAGE INCREASE USING LOW DAMS,
Massachusetts Univ, Amherst.
Karl N. Hendrickson.
OWRR Project A-016-Mass, Water Res Center, Interim Rep, Jan 1967. 20 p, 8 ref.

Descriptors: Groundwater, Hydrographs, Infiltration, Rainfall, Runoff, *Water yield improvement, Hydrology, Research and development, *Small watersheds, Retention, Evaptranspiration, Hydrologic budget, Water storage, Benefit-cost ratios, Dams.
Identifiers: Base flow, *Low dams, *Retention dams.

Information generated by experimental watersheds, hydrology investigations, and new statistical methods is so great and sophisticated that only large projects can afford to exploit it properly. Great areas of the country are made up of town and city-owned small watersheds not producing all the water that they could because of underdevelopment of ground water capacity for charging. Lo

dams reduce runoff and provide a longer period for infiltration. This increases duration and amount of base flow. A simple, rational method of appraising, designing, and estimating the value of low dams is presented. The scheme consists of estimating base flow, infiltration capacity, and evaporation from a short summer rainfall by observing the amount and duration of the rain, runoff of the stream and change of the water table. From this data, probable change as the result of construction of a low dam is estimated. Change is related to the domestic price of water and its probable value to the system to determine project economy. A case study is used to illustrate the method.
W69-00417

WATER RIGHTS LITIGATION,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00521

LEGAL ASPECTS OF WEATHER MODIFICATION-SNOWPACK AUGMENTATION IN WYOMING,
Wyoming Univ, Laramie.
John M. Pierce.
Water Resour Ser No 11, Univ Wyoming, Laramie, June 1968. 59 p, suppl, 236 ref.

Descriptors: Atmospheric precipitation, *Weather modification, *Laws, Weather, Cloud seeding, Riparian rights, Liabilities, Bibliographies, Natural resources, Agreements, Claims, Damages.
Identifiers: Snow pack, Atmospheric research, *Legal aspects, USBR Research Contracts, *Legislation, Wyoming, Ownership, Snowfall.

At the present time the legal aspects of weather modification are undefined. Few cases have been decided and there is no legal consensus of either the control and ownership of clouds and the moisture therein or of the liability of the weather modifier. Twenty two states have enacted legislation regulating weather modification activities; most statutes amount to no more than token regulation. The need for Federal regulation of weather modification has been expressed in the Congress. If states continue to make no more than token regulations, pressure will force the Federal government to take over all facets of weather modification. Most theories advanced for determining ownership of clouds and moisture therein are based on rules and theories used in other areas of natural resources. Little new thinking has developed with consequent little attempt being made to adjust legal thinking in scientific areas. Unless new ideas are presented and adlpted by the legislatures and courts, the legal profession will have failed in its obligation to society. Now is the time for legal institutions to act so that development can take place independent of pressures, and proper recognition can be given to social and economic effects that my result. (USBR)
W69-00612

STORAGE REQUIREMENTS FOR WATER IN THE UNITED STATES,
Resources for the Future, and U S Geological Survey, Washington, D. C.
George O. G. Lof, and Clayton H. Hardison.
Water Resources Res, Vol 2, No 3, pp 323-354, 1966. 32 p, 6 fig, 11 tab, 9 ref.

Descriptors: *Water storage, *Reservoir storage, *Regulated flow, *Dams, *Cost analysis, Routing, Water management (Applied), Evaporation.
Identifiers: Water storage requirements.

Storage requirements for various levels of streamflow regulation in the 22 major regions of the contiguous U S are presented to supersede those given in Committee Print 32 of the Select Committee on National Water Resources, U S Senate. At levels of development, the storage required to provide the desired flow in 95 and 98% of the years is substantially larger than that previously given. Carry-over storage requirements based on probability routing of annual discharge are combined with seasonal storage requirements to give the revised storage requirements, which are then used to compute revised evaporation losses and revised cost estimates by the methods previously used. The maximum net flow that could be made available for the 22 regions for 98% of the years is shown to be 965 billion gal per day (bgd) for which a storage capacity of 3.6 billion acre-ft would be required. A net flow of 922 bgd could be made available with 2 billion acre-ft of storage. Any increment of flow above the 922 bgd figure would have storage costs exceeding 10 cents per thousand gal delivered. (Knapp-USGS)
W69-00696

3E. Conservation in Industry

THE AVAILABILITY OF WATER FOR INDUSTRIAL USES IN SELECTED SMALL COMMUNITIES IN MISSISSIPPI,
Mississippi State Univ., State College.
Guy T. Peden, Jr., and Van N. Oliphant.
Water Resour Res Inst Rep, June 1967. 101 p, 4 fig, 16 tab. OWRR Project A-011-Miss.

Descriptors: Bibliographies, Water, Industries, Rural areas, Water requirements, *Industrial water, Mississippi, *Water supply, Social aspects, Rainfall, Groundwater, Aquifers, Water wells.

This study was undertaken to determine availability of water for industrial uses in selected small communities in Mississippi. Results show that water is available for industrial uses in these communities. Several communities did not have all of the water information requested. Ground water is the source of supply for all communities in the study. Aquifers servicing these communities yield continuing supplies of excellent to good quality water. None of the communities foresees any problem in its future water supply. The majority of the communities have excess capacities which can supply relatively large amounts of water. Increasing demands by industrial, residential, and commercial users may force these communities to expand their facilities. The majority of the industries in the area depend on community facilities for water supply. Several industries and the largest individual users have privately owned industrial wells. Industries in the study area use water in quantities ranging from several hundred gallons per month to over 40 million gallons per month. The majority of the industries in the study area stated that they did not locate at their present location primarily because of available water.
W69-00633

WATER: AS A FACTOR TO ATTRACT INDUSTRIES,
Ministry of Agriculture, Ankara, Turkey.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-00650

3F. Conservation in Agriculture

DEVELOPMENT OF METHODS FOR INCREASING THE EFFICIENCY OF WATER USE IN CRANBERRIES,
Massachusetts Univ, Amherst.
John S. Norton.
OWRR Project A-005-Mass, Pap, Symp Water Resour Res, Univ Massachusetts, June 1967. 16 p, 15 fig, 1 tab.

Descriptors: *Cranberries, *Dikes, Irrigation systems, Irrigation efficiency, *Flood irrigation, *Water harvesting, Bogs, Equipment.

Materials were procured for an assortment of temporary dikes for cranberry bogs and 7 dikes were built. Two dikes were vinyl sheeting supported on railings and anchored below ground by 1 by 2 in. wood strips. One dike was aluminum, supported by a wood railing. Three dikes were earth with sheet aluminum cores. Two of the earthen dikes were built over filled-in ditches, the third built on bog surface. The seventh dike was erected on private property but removed prior to testing. Only the sheet vinyl and aluminum dikes were constructed in time for testing in 1966. Considerable difficulty was experienced because of washouts under both the vinyl and aluminum sheeting. Tests will be made on all dikes in 1967 in conjunction with work under Hatch Project No 51. The current trend toward water harvest methods. The equipment consists of an elevator to remove the berries from the water surface, and a blower, ducting, and screen to separate debris from the berries before they are loaded into trucks.
W69-00412

THE DISTRIBUTION AND PERSISTENCE OF DIAZINON APPLIED TO PLANT AND SOIL AND ITS INFLUENCE ON RHIZOSPHERE AND SOIL MICROFLORA,
Institute of Agricultural and Industrial Microbiology, Amherst and the Cranberry Experiment Station, East Wareham, Mass.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00414

PHYSICAL AND ECONOMICAL ASPECTS OF CONJUNCTIVE USE OF IRRIGATION WATER IN SMITH VALLEY, LYON COUNTY, NEVADA,
Nevada Univ., Reno, Desert Res. Inst.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00466

WATER CONSERVATION.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00502

FACILITIES FOR WATER STORAGE AND UTILIZATION.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00503

WATER CONSERVATION AND UTILIZATION PROJECTS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00504

HYDRAULICALLY CONTROLLED BUTTERFLY GATES IN FARM LATERAL TURNOUTS FOR AUTOMATION OF SURFACE IRRIGATION SYSTEMS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-00588

AGRICULTURAL WATER CONSIDERATIONS IN DEVELOPING STATE WATER PLANS,
Texas A and M Univ., College Station.
Fred A. Schmer, and Carroll W. Keese.
Water Resour Inst Rep, 1966. 13 p, 5 fig, 1 tab.

Descriptors: *Agriculture, *Water development, Water costs, Economics, Irrigation, Water requirements, Water users, Crops, Water resources, Texas, Water utilization, Water resources development.
Identifiers: *Water plans.

Agriculture presently accounts for one-third or more of the total water use depending on how we define use. If we define use as making water completely unavailable for other uses, agriculture accounts for a higher portion of the water used. Some estimate that 85% of withdrawal can be at-

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tributed to agriculture. Therefore, water for agriculture is of utmost concern in developing a water plan. Agricultural use is defined in this paper as water used for irrigation. In the analysis of agricultural resources related to water development in Texas an attempt was made to present to water planners the effect of unlimited water availability to agriculture and the effect of water being available to agriculture at a relative cost similar to that at the present time. Agriculture in Texas, and most other areas, cannot compete for water simply on the basis of need for agricultural production. Efficiency of this production and effect of irrigation and related industry on the total economy must be analysed if additional water is to be allocated to agriculture in the future.
W69-00607

COSTS AND RETURNS FROM CROPS AND LIVESTOCK IN THE UPLAND DESERT VALLEYS OF NEVADA,
Nevada Univ., Reno.
LeRoy F. Rogers, and William V. Neely.
OWRR Project-A-011-Nev. Desert Res Inst Prog Rep No 2, 58 p, 1 fig, 30 tab, 5 ref, append.

Descriptors: Land, Agriculture, *Land development, Land use, Land appraisal, Land management, *Cultivated lands, *Farm management, Costs, Economics, Ranges, Livestock, Forage palatability, Crops, Nevada, Arid lands, *Deserts, Valleys.

Data on selected crop and livestock enterprises are presented to aid current and prospective operators in planning desert valley development in Nevada. The report covers costs for clearing, tillage, water, fencing, crop development, and social and community development. Enterprise budgets were developed for Diamond Valley, Orovado District, Middle Reese Valley, and Antelope Valley.
W69-00638

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on THE Surface

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1960. (Parts 3 and 4. Ohio River Basin and St. Lawrence River Basin).
U S Geological Survey.

U S Geol Surv Water-Supply Pap 1742, pp 1-309, 1968. 309 p, 1 fig, 79 ref.

Descriptors: *Data collections, *Water quality, *Surface waters, *Ohio River, *St. Lawrence River.
Identifiers: Ohio River Basin, St. Lawrence River Basin.

Records of chemical analysis, suspended sediment, and temperature are compiled for waters of the Ohio and St. Lawrence River Basins for 1960. The data collected at the 136 stations on 78 streams include chemical analysis reports on silica, Fe, Ca, Mg, Na, K, carbonate, bicarbonate, sulfate, C1, F, nitrate, B, pH, total dissolved solids, specific conductance, discharge, suspended sediment load, and particle size analyses. Al, Mn, color, acidity, oxygen consumed, phenolic material, and minor elements are reported for a few streams. (Knapp-USGS)
W69-00431

MAP INTERPRETATION AND CLASSIFICATION OF BURIED VALLEYS,
Massachusetts Univ, Amherst.
Marvin Saines.
Ground Water, Vol 6, No 4, pp 32-37, July-Aug 1968. 6 p, 5 fig, 13 ref.

Descriptors: *Terrain analysis, *Valleys, *Glacial drift, Water sources, Superimposed drainage, Topography, Maps.
Identifiers: *Map interpretation, *Buried valleys, Deranged drainage.

Types of buried valleys are described and four examples are given of topographic map interpretation as related to water resources studies and the development of groundwater supplies. Buried valleys are the source of about 80% of the water pumped from glaciated areas in Ohio and other states. The two main types are: (Type I) valley completely buried by glacial drift without present streams along their courses, and (Type II) valleys that are partly buried or partly exhumed usually with streams along their courses. If a stream is flowing mainly in a Type II valley, the bottom of which is deeply buried by drift, local areas where the stream is cutting bedrock are postglacial channels of derangement. Postglacial channels of derangement, which often can be recognized on a topographic map, reveal that a buried valley (often Type I) exists nearby. (Knapp-USGS)
W69-00437

FALL WATER SUPPLY SUMMARY FOR NEVADA,
Dept of Agriculture, Soil Conservation Service, Reno, Nevada.
Bob L. Whaley, and Roy E. Malsor, Jr.
Soil Conserv Serv Water Supply Rep, Oct 1, 1968. 5 p, 4 tab.

Descriptors: *Water supply, *Forecasting, Groundwater, Streamflow, Reservoir storage, Snowmelt, Nevada, Soil moisture.

As forecast, extremely low streamflow has been experienced throughout Nevada this past season. In most areas, the streams peaked 2 to 3 weeks earlier than normal, and the flows likewise fell off much earlier than usual. Water users served from reservoirs have had a fairly adequate water supply, due to last year's good reservoir carryover. The heavy reservoir usage to augment the low streamflow left below-average amounts of water in storage in most of the reservoirs throughout the state. Streamflow ranged from a low of 9 to 19% on the Owyhee up to 73% on the Upper Carson River. The Humboldt River flowed less than 50% of average for the season. Above-normal June precipitation on the Humboldt added materially to the runoff this yr. Fall soil moisture surveys indicate that the mountain soils on the east slope of the Sierras are extremely dry. Soils in the Humboldt and Owyhee Basins are near average, however. This dry condition, coupled with the depleted reservoir storage, indicates the need for a normal or above normal snowpack this coming winter season in order to insure an adequate water supply next season. Tables and graphs show streamflow, reservoir storage, and soil moisture as of Oct 1, 1968. (Knapp-USGS)
W69-00439

STATE ROAD AND EBNER COULEES, WISCONSIN.
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 360, 57 p, 1968. 3 plate, 6 tab, 1 attach, 1 append.

Descriptors: *Flood control, *Channel improvement, *Diversion, Wisconsin, Cost-benefit analysis, Diversion structures, Relocation, Community development, Urbanization.
Identifiers: LaCross, Wisconsin, Urban developments.

Floods on State Road and Ebner Coulees, LaCrosse, Wisconsin were studied and control measures are suggested. The floods are caused by high rates of runoff from rugged terrain in upper reaches of the watersheds. Predicted damages are $351,700 in 1970 and $578,000 in 2020 without control. The suggested plan includes channel improvements and diversion works leading from Ebner Coulee to the LaCrosse River. The estimated first cost is $4,495,000 and annual costs a $192,000. The benefit-cost ratio is 1.36. (Knap USGS)
W69-00440

NAVASOTA RIVER WATERSHED, TEXA (BASIN DEVELOPMENT STUDY REPORT).
Army Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 341, 2 p, 1968. 16 fig, 2 plate, 64 tab, 3 append.

Descriptors: *Flood control, *Water suppl *Recreation facilities, *Reservoirs, Texas, Chann improvement, Cost-benefit analysis, Water d mand, Water yield, Hydrogeology, Aquifers, Su face waters.
Identifiers: *Navasota River Basin, Brazos Riv Basin.

A study of the Navasota River watershed, Texa was made and it was decided that the authorize water supply and flood control project for Braz River and Tributaries, Texas, be modified to pr vide for the construction of Millican and Navaso no. 2 Reservoirs with channel improvements flowing easements, instead of the authorized Fe guson River Project. The estimated first cost $119,707,000, the annual cost is $229,000 and t benefit-cost ratio is 2.8. The present water use the Lower Brazos Basin is 340 mgd and is expect to increase to 1,326 mgd in 2025 and 2,088 mgd 2075. Present supplies will be inadequate by 198 requiring development of Navasota River wat supplies. Irrigation and power projects are not i cluded because they would yield less benefit tha costs. Detailed hydrologic, water resources, a economic data are tabulated. (Knapp-USGS)
W69-00442

ALABAMA GREAT SOUTHERN RR CO BROACH (SURFACE RUNOFF - PROOF AN DAMAGES).

119 So 2d 923-925 (Miss 1960).

Descriptors: *Judicial decisions, Mississippi, *Su face runoff, Surface drainage, *Landfills, Bound ries (Property), Rainfall, Damages, Legal aspect Water law.
Identifiers: Damages (Legal aspects).

Plaintiff sought damages from the defendant ra road company, due to the alleged discharge of su face waters on plaintiff's property. Plaintiff alleg that this discharge was due to the railroad's filli of its land and the slight encroachment of this f on plaintiff's land. At trial the railroad admitt such encroachment, which occurred because plai tiff had set his fence back several feet from the pr perty line. However, the railroad did dispute the legation that the fill materially increased the flow surface waters onto plaintiff's land. The trial cou directed a verdict for plaintiff, submitting on t issue of damages to the jury, with a very general i struction. On appeal to the Mississippi Supren Court the case was reversed and remanded. T court held: (1) a verdict may not be directed whe only one of two issues in the case was establish without dispute; and (2) that an instruction damages not furnishing the jury with any guide wi reference to the rules of measurement of damag in surface water cases was in error. (R. F. Willian Fla)
W69-00473

HAMMONS V ILLINOIS CENTRAL R R (SU FACE RUNOFF--FLASH FLOODS).

119 So 2d 846-848 (La 1960).

Descriptors: *Judicial decisions, Louisiana, *Su face runoff, Surface drainage, Ditches, Drains, C verts, *Flash floods, Flood damage, Excessi precipitation, Obstruction to flow.

Plaintiff sued the railroad for property damage caused by flooding allegedly due to the blocking of the natural drainage from plaintiff's land by the railroad's roadbed. Plaintiff also contended that defendant's failure to construct a drain under its roadbed, and its improper construction of a drainage ditch along its right of way contrary to the grade, caused his damage. Defendant denied these allegations and averred that the drainage ditch was built by public authorities and not the railroad. The trial court found that the flood damage was due to a heavy rain and flashflood which was of the type to occur 'once in a decade,' and that the drainage ditch along the roadbed was built in collaboration with public officials, for the town's interests, not those of the railroad. Accordingly, the trial court found for the defendant. On appeal, the Louisiana Supreme Court affirmed the decision. Due to the unusual nature of the rain, plaintiff failed to prove negligence. He also failed to prove his loss was a result of defendant's commission or omission. (R. F. Williams-Fla)
W69-00474

BURSON V SALIBA (SURFACE RUNOFF IN ALABAMA).
116 So 2d 609-610 (Ala 1960).

Descriptors: *Judicial decisions, Alabama, *Repulsion (Legal aspects), *Surface runoff, Surface drainage, Obstruction to flow, Rainfall, Ditches.

Plaintiff Burson, owner of an upper lot in a municipality, sought a mandatory injunction and damages against Saliba, the adjoining lower landowner. Plaintiff sought to require defendant to remove a retaining wall and part of a building which it had built at the property line, and which allegedly blocked the natural flow of surface water from plaintiff's to defendant's land, thereby causing flooding conditions. Defendant's demurrer was sustained and plaintiff appealed. The Alabama Supreme Court held that the demurrer was properly sustained. The defendant breached no duty to plaintiff, and therefore there was no actionable negligence. A lower proprietor in an incorporated town or city can obstruct the flow of surface water from higher ground over his property even though it is the only way such water may pass. The sole reason for this is because the property happens to be in an incorporated area. Also, rainfall in a drainage ditch is not accorded the same rights as a defined, distinct stream. (R. F. Williams-Fla)
W69-00479

MONTGOMERY V DOWNEY (SURFACE DRAINAGE).
162 N E 2d 6-12 (1959); 17 111 2d 451.

Descriptors: Drainage water, Floodwater, *Return flow, Riparian waters, *Surface drainage, *Natural flow doctrine, Surface waters, Downstream, Upstream, Flow, *Levees, *Channels, Retaining walls, Judicial decisions, Illinois, Surface runoff, Prescriptive rights, Water law.
Identifiers: Dominant estate, Servient estate, Easements of drainage.

Suit to compel defendants to remove alleged obstructions to the natural flow of surface waters from adjoining lands of the plaintiff. It is alleged that certain work done by the defendants on a levee prevented sufficient drainage from plaintiff's dominant estate, and caused surface waters to back up and stand on plaintiff's land. The court held that once such an obstruction has been maintained for the prescriptive period, it may be said to have ripened into an easement and the owner of the servient estate then has the right to maintain the levee or obstruction at its original height and make such repairs as may be required to maintain it. However, in the absence of further expansion of the easement by prescription, the right to maintain does not permit raising the levee so as to cause damage to the land of the plaintiff. Plaintiffs failed to sustain the burden of proving injury to their land greater than that which the land had for many years sustained in times of flooding. The court thus found that the maintenance done by the defendants was within the permissive category. Judgment was rendered in form of the defendant. (Kuder-Fla)
W69-00482

JOHNSON V GOODVIEW (SURFACE DRAINAGE).

167 N E 2d 132-139 (Ohio Com Pl 1960).

Descriptors: Construction, Controlled drainage, Landscaping, *Drainage effects, Rainfall disposition, Return flow, *Surface drainage, *Surface runoff, Excess water, Rural areas, Cities, Reasonable use, Judicial decisions, Flow, Water law, Repulsion (Legal aspects), Ohio, Natural flow.
Identifiers: Civil law rule, Servient estate, Trespass.

Action by owner of lower city property against owner of higher city property for damages caused by the flow of surface water from higher to lower land. The court distinguished the urban from the rural law governing this situation. Under the urban rule, the owner of lower land is not bound to accept natural surface water flowing from adjoining higher land. There is no liability upon the lower owner if he raises the grade of his property in a reasonable manner, even though in so doing he obstructs the natural flow of surface water to back up and stand upon the higher land. Under the rural rule, however, the lower owner is bound to accept natural surface waters flowing from upper land with no liability on the part of the upper owner. The court points out, however, that there are several exceptions to this latter rule. Employing the urban rule, the court held that the defendant in constructing apartment houses and parking lots upon the higher land, and thereby increasing and diverting the flow of surface water upon the lower adjoining property, were liable for damages caused to the lower land. (Kuder-Fla)
W69-00483

KAZANAKY V BERGMAN (SURFACE RUNOFF).

17 Misc 2d 1015; 192 NYS 2d 302-304 (1959).

Descriptors: *Judicial decisions, New York, *Surface runoff, Surface waters, Surface drainage, Water injury, *Dams, Outlets, Pipes.
Identifiers: Evidence.

Plaintiff brought an action for injunctive relief and damages against defendant, who owned a contiguous tract of land with a higher elevation than that of plaintiff. Defendant had constructed a horseshow shaped dam which captured surface and perfolating waters from his land. Two pipes discharged any overflow which might occur, and these waters eventually found their way onto plaintiff's land. The dam did not leak nor did any water spill over the top. Plaintiff alleged that this was a diversion of surface water onto his land, causing a wet and marshy condition. The trial judge stated that in New York there is no discrimination between upper and lower proprietors, neither be dominant or servient to the other. Owners may improve their property, with only the limitation that they do so in good faith, and abstain from draining surface water onto their neighbor's property by pipes or ditches. Plaintiff failed to established a causal connection between the condition of his land and the pipes in defendant's dam. It appeared that such conditions resulted only from natural causes. Judgment was for defendant. (R. F. Williams-Fla)
W69-00490

DISCOVERY, DEVELOPMENT, AND MARKING OF WATER HOLES, ETC, BY GOVERNMENT.

43 USCA Secs 361-363.

Descriptors: *Arid lands, *Water holes, Locating, Sites, *Legislation, Public lands, Federal government, Fouling, *Water resources development, Appliances, Maps, Springs, Streams, Public benefits.
Identifiers: *Secretary of the Interior, Marking of water holes, Monuments, Signboards, Defacing of signposts, Crimes.

Section 361 empowers the Secretary of the Interior to: (1) discover, develop, and render more accessible for public benefit, springs, streams, and water holes on arid public lands of the United States; (2) erect and maintain signposts and monuments at intervals along the accustomed lines of travel, containing information and directions as to the location and nature of such water holes; (3) provide convenient means and appliances by which water may be brought to the earth's surface at the water holes; (4) prepare and distribute maps, reports, and general information relating to the water holes and their specific locations. Section 362 makes it a crime to willfully or maliciously injure, destroy, deface, or remove any of the signposts or monuments, or to willfully or maliciously fill up, render foul, or in any way destroy or impair the utility of the water holes. Section 363 authorizes the Secretary to make such regulations as may be necessary to effectuate the purposes of the act. (Smodish-Fla)
W69-00506

RIPARIAN RIGHTS AND DUTIES,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00513

MCGIBNEY V WAUCOMA YACHT CLUB INC (DOCKS - RIPARIAN LAND).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00514

RECENT DEVELOPMENTS IN RESOURCES AND UTILITIES LAW,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00517

FLOOD CONTROL REGULATIONS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00526

REGULATION OF THE DEVELOPMENT OF WATER POWER AND RESOURCES.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00531

KNIGHT V CIARLONE (INTERFERENCE WITH LITTORAL RIGHTS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00535

RANDLE V CITY OF ROME (MUNICIPAL LIABILITY FOR STORM DRAINS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00537

FAIRCHILD V KRAEMER (PUBLIC RIGHTS IN TIDAL MARSHES).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00538

SMITH V PEOPLE (LANDS APPROPRIATED FOR STATE RESERVOIR).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00539

LIBRARY U. OF I. URBANA - CHAMPAIGN

ESSOCK V TOWN OF COLD SPRING (DRAINAGE DITCH).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00543

OAKLAND CLUB V CITY OF SOUTH EUCLID (SURFACE RUNOFF).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00545

EBERLE V GREENE (OBSTRUCTION OF SURFACE WATER FLOW).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00546

FURTEK V WEST DEER TOWNSHIP (SURFACE DRAINAGE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00550

RULES OF CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00565

OPTIMIZATION OF THE OPERATION OF A MULTIPLE-PURPOSE RESERVOIR BY DYNAMIC PROGRAMMING,
California Univ, Los Angeles.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00596

IN-SITU DETERMINATION OF AQUIFER PARAMETERS FOR USE IN THE DRAINAGE FUNCTIONS,
Utah State Univ, Logan.
S. Abdollah Jenab, Dean F. Peterson, and A. Alvin Bishop.
Pap 68-203, Amer Soc Agr Eng 1968 Annu Meet, Logan, Utah, June 1968. 37 p, 12 fig, 14 tab, 6 ref.

Descriptors: *Ground water, *Groundwater flow, *Drainage, Mathematical analysis, Aquifers, Drainage systems, Hydraulic conductivity, Discharge coefficients, Thickness, Water table, Field tests, Seepage, Porosity, Specific yield.
Identifiers: In situ tests, Glover equation, Drainage yield, Drain spacing.

Important aquifer characteristics in drainage design are hydraulic conductivity, aquifer thickness, and specific yield. Hydraulic conductivity measured in the laboratory is not reliable for field use, aquifer thickness is very hard to measure, and specific yield is an elusive variable. Most authors assume specific yield to be constant; others contend that it changes with depth to water table. Experience shows that water table height calculated from laboratory data does not agree with observed values in the field. Field measurements of aquifer characteristics are desirable to predict true fluctuations of ground water. Two field methods (constant discharge and constant head) were evaluated for measuring in situ aquifer parameters. Parameters are determined with transient functions and may be used in drainage and drainage discharge functions for designing drainage systems. Examples are given for the design. (USBR)
W69-00602

GROUND WATER REGULATION IN THE COASTAL FLATWOODS OF MISSISSIPPI,
Mississippi State Univ., State College.
For primary bibliographic entry see Field 02I.
For abstract, see .
W69-00635

SEEPAGE FLOW THROUGH AN EARTH DAM,
Georgia Inst. of Tech., Atlanta, Civil Engineering Sch.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00665

SALT-WATER INTRUSION EFFECT OF A FRESH-WATER CANAL,
Georgia Inst. of Tech., Atlanta, Civil Eng. Sch.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-00667

CONFLUENCE ANALYSES OF LAND SURFACES,
Wyoming Univ., Laramie, Eng. Coll.
For primary bibliographic entry see Field 06F.
For abstract, see .
W69-00671

MISSISSIPPI RIVER FROM CASSVILLE, WISCONSIN, TO MILE 300.
U S Army Corps of Engineers, Washington, D C.

U S 90th Congr, 2d Sess, House Doc No 348, 128 p, 1968. 7 plate, 13 tab, 1 attach, 1 append.

Descriptors: *Flood control, *Iowa, *Illinois, *Mississippi River, Levees, Drainage systems, Cost-benefit analysis.

Data on flooding in the upper Mississippi River Basin are reviewed and plans for flood protection of Clinton and Bettendorf, Iowa, and Fulton, East Moline, and Milan, Illinois, are presented. Flood protection plans for the 5 cities were found to be economically justifiable. The improvements recommended would consist of levees, floodwalls, interior drainage facilities, and remedial work on railroads, utilities, and other structures. Flood control cost is $9,200,000 with a 2.8 to 1 benefit-cost ratio in Clinton, Iowa, $4,470,000 and 1.1 to 1 in Fulton, Illinois, $2,150,000 and 2.1 to 1 in Bettendorf, Iowa, $4,270,000 and 1.4 to 1 in East Moline, Illinois, and $1,210,000 and 1.9 to 1 in Milan, Illinois. (Knapp-USGS)
W69-00689

PRELIMINARY ESTIMATES OF LOW-FLOW FREQUENCY INTERRELATIONS FOR UPSTATE NEW YORK STREAMS,
U S Geological Survey, Albany, New York, Water Resources Division.
Robert M. Beall.
U S Geol Surv Prof Pap 600-C, pp C196-C198, 1968. 3 p, 1 fig, 3 ref.

Descriptors: *Low flow, *Frequency analysis, Statistical methods, Hydrographs, Discharge (Water), Base flow, New York, Flow characteristics.
Identifiers: *Low-flow frequency, Upstate New York streams.

Reasonably accurate values of mean annual discharge and of the annual low flow having a recurrence interval of 2 years usually can be obtained from short-term secondary or partial-record station data by correlation with long-term station data. At 125 sites in or near upstate New York where more than 20 years of daily discharge data have been collected, these flow characteristics have been related to annual low flows with recurrence intervals of 10, 20, and 50 years. The relation is shown as a family of curves from which long-term return period discharge may be estimated within accuracy limits of about 1% of the mean annual flow. (Knapp-USGS)
W69-00693

4B. Groundwater Management

GEOCHEMICAL INVESTIGATION OF THE GROUNDWATER SYSTEM IN THE LANSING, MICHIGAN AREA,
Michigan State Univ, East Lansing, Dept Agricultural Eng.
Samuel B. Romberger.
Water Resour Res Terminal Rep, Apr-June 1967. 19 p, 2 fig, 3 tab. OWRR Project B-007-Mich.

Descriptors: Geochemistry, *Groundwater, Michigan, Acidity, *Analysis, Soil chemistry, Mineralogy, Solubility.
Identifiers: Aquifer geochemistry.

The factors controlling the chemistry of ground water are presently being studied in the upper Grand River drainage basin in central Michigan. Representative subsurface water samples have been collected and analysed for sodium, potassium, calcium, magnesium, iron, chloride, and sulfate. The chemical nature of the water changes with respect to pH, and the concentration of bicarbonate and iron, as it is brought to the surface from the depth of sampling. Therefore, it is necessary to measure these immediately after sampling in the field in order to obtain values representative of the water at depth. Values for these three quantities obtained in sampling and analysis. Analytical procedures for use in the field and in the laboratory have been developed so that a large number of samples can be collected and analysed rapidly with good accuracy and precision. Standard titration methods are used for bicarbonate and chloride; colorimeter methods for iron in the field and for sulfate; spectrometric methods for sodium, potassium, calcium, magnesium, and iron in the laboratory; and the pH is measured using a standard field pH meter. The results will be compared with the chemistry of the aquifer material, and with the composition of soils and surface materials to determine the relationship between them.
W69-00421

REGIONAL GEOLOGY AND GROUNDWATER HYDROLOGY OF THE SAHIL AREA, TUNISIA,
U S Geological Survey.
L. C. Dutcher, and H. E. Thomas.
U S Geol Surv Water-Supply Pap 1757-G, pp G1 G53, 1968. 53 p, 3 fig, 4 plate, 25 ref.

Descriptors: *Geology, *Water resources, *Hydrogeology, *Groundwater, *Arid lands, Water wells, Hydrologic data, Aquifers, Water quality, Logging (Recording), Groundwater basins, Water sources.
Identifiers: Tunisia, Sahil Susah, Tunisia.

The regional geologic and hydrologic features of the Sahil Susah area, in central Tunisia are discussed. The area has poor water resources which may be inadequate for the existing population of 447,000. The region is arid, and most of the small amount of precipitation falls on the mountains. Runoff and evaporation are high so that very little water is recharged to the ground, and dissolved solids are high. Saline lakes and salt-filled depressions are common. The rocks of the area are complexly folded and faulted, dividing it into a large number of groundwater basins. Shallow wells yield water everywhere in the area, but much of it is too saline to use. Fine sand impairs performance of many of the wells drilled for the study. Water in deeper formations is fresh only in the parts of the area where height and relief have permitted flushing. Water in deeper rocks under the low steppe and coastal area is saline. Maps show geology, well locations, piezometric contours, areas of artesian flow, and extent of aquifers. (Knapp-USGS)
W69-00429

GROUND-WATER RESOURCES OF THE AC VALLEY, RIO GRANDE DO NORTE, BRAZIL,
U S Geological Survey.
Harry G. Rodis, and Jonas Maria de Castro Araujo

U S Geol Surv Water-Supply Pap 1663-C, pp C1-C34, 1968. 34 p, 2 fig, 1 plate, 4 tab, 14 ref.

Descriptors: *Groundwater movement, *Natural recharge, *Water quality, Evapotranspiration, Recirculated water, Aquifers.
Identifiers: *Acu Valley, *Rio Grande do Norte, *Brazil.

To determine the availability of groundwater in and around the Acu Valley, Brazil, inter-governmental research was conducted. Estimated natural recharge alone is probably 2 1/2 to 5 times as the water pumped from wells in 1964 and may be increased by water introduced from upstream by the river, or by water moving underground from other adjacent aquifers. Recirculation of water infiltrating the water table will gradually cause an increase in dissolved solids in the water. Ground water quality is generally good; dissolved minerals will not affect irrigation in the Valley for some time and quality is not likely to deteriorate because of the relatively rapid circulation and renewal of water in the aquifer. Evapotranspiration will also tend to increase dissolved substances in water, and salts in soil. Water from alluvium is generally potable and can be used for municipal water supplies and other purposes. Wells in the alluvium yield up to 30,000 l/hr. Considerable water is available from the Acu Sandstone and the Jandaira Limestone deposits, but it is highly mineralized and is not of acceptable quality for human consumption at some spots. (Laverias-USGS)
W69-00430

GROUND-WATER HYDROLOGY OF THE SEVIER DESERT, UTAH,
U S Geological Survey.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00432

DESIGN AND CONSTRUCTION OF A DUAL RECHARGE SYSTEM AT MINOT, NORTH DAKOTA,
U S Geological Survey, Bismarck, North Dakota.
Wayne A. Pettyjohn.
Ground Water, Vol 6, No 4, pp 4-8, July-Aug 1968. 5 p, 2 fig, 1 tab, 1 ref.

Descriptors: *Recharge, *Pit recharge, *Recharge wells, Surface-groundwater relationships, Cost-benefit analysis, Cost comparisons, Water conveyance.
Identifiers: *Dual recharge, Perforated pit recharge.

A groundwater recharge facility was constructed in 1965 and placed in operation to forestall an impending water shortage at Minot, North Dakota. The facility is unique in that the rate of recharge to a buried sand and gravel aquifer is augmented by perforating an overlying bed of clay using hydraulic connectors (gravel-filled bored holes) in conjunction with an open-pit excavation. The connectors were drilled by typical well-boring techniques and the open pit was excavated by common construction methods. The recharge technique made it possible to add about 4.5 million gallons per day of water to underground storage with a total capital investment of about $200,000. The alternative originally proposed was a 50-mile long pipeline to Garrison Reservoir, at a 1959 estimated cost of $12,000,000. The recharge technique employed at Minot should have wide application in the groundwater industry in areas where natural recharge to permeable deposits is impeded by overlying beds of low permeability. (Knapp-USGS)
W69-00433

THE RELATIONSHIP BETWEEN SPECIFIC CAPACITY AND AQUIFER TRANSMISSIBILITY IN THE HOUSTON AREA, TEXAS,
U S Geological Survey, Houston, Texas.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00435

ESTIMATING COST OF GROUND-WATER WITHDRAWAL FOR RIVER BASIN PLANNING,
U S Geological Survey, Water Resources Division.
For primary bibliographic entry see Field 06C.
For abstract, see .
W69-00436

PHYSICAL AND ECONOMICAL ASPECTS OF CONJUNCTIVE USE OF IRRIGATION WATER IN SMITH VALLEY, LYON COUNTY, NEVADA,
Nevada Univ., Reno, Desert Res. Inst.
P. A. Domenico, D. F. Schulke, and G. B. Maxey.

Hydrol Water Resour Publ 1, Tech Rep Series 2, July 1966. 47 p, 19 fig, 4 tab, 13 ref. OWRR Proj B-007-Nev.

Descriptors: Groundwater, *Conjunctive use, *Optimum development plans, *Supplemental irrigation, *Water management (Applied), Water costs, Consolidation, Surface-groundwater relationships, Optimization, Water utilization, Pumped storage, Water allocation (Policy), Water resources development, Surface waters, Water distribution (Applied).

Supplemental irrigation wells in Smith Valley are individually owned and operated and can be used in conjunction with surface water to irrigate about 6300 acres of land whereas an additional 8700 acres have surface water rights only. Ground water is now used only to the extent of deficiencies in surface water supplies and as a late season requirement during years of normal or above-normal flow, or about 2 out of every 5 yr based on historical deficiencies. Most conjunctive appropriators are now virtually assured of a full supply of irrigation water every season regardless of flow of West Walker River. On the basis of historic flow and well yield and assuming centralized or district operation of the well fields for the benefit of the entire valley, existing pumping facilities could provide about 93% assurance of a full supply of irrigation water for all appropriators in Smith Valley. Further, analysis based on returns from ranching and cost of supplemental pumping for various levels of demand, efficiency, and lift, indicates that more water could be pumped cheaper with existing wells if the operation were centralized instead of under individual control. One suggestion is that the operating water district purchase and operate wells as 'sole owner,' thus providing water for benefit of the entire area.
W69-00466

ARTIFICIAL RECHARGE AND ITS ROLE IN SCIENTIFIC WATER MANAGEMENT, WITH EMPHASIS ON LONG ISLAND, NEW YORK,
US Geological Survey, Albany and Mineola, N Y.
Gerald G. Parker, Philip Cohen, and Bruce L. Foxworthy.
Pap, Proc Ser No 4, Symp Amer Water Resour Ass, San Francisco, Calif, pp 193-213, Nov 1967. 21 p, 5 fig, 2 tab, 56 ref.

Descriptors: *Aquifers, *Ground water, *Groundwater recharge, Seepage, Water conservation, Water management, Water quality, Water development, Water resources, Water sources, Water storage, Salt water barriers, Sea water intrusion, Watersheds, Flood control, Recharge wells, Underground water storage, Basins, Permeability, Bibliographies.
Identifiers: San Joaquin Valley, Calif, Long Island, N Y, Israel.

Water resources development and comprehensive management are discussed with particular emphasis on ground-water reservoirs and artificial recharge to achieve optimum benefit from available water resources. Aquifers must be managed so that storage will be reduced during peak consumption and replenished by recharge during periods of surplus surface water. Artificial recharge practices can (1) capture and store excess water, (2) alleviate flooding, (3) improve water quality, (4) store cooling water or heat for industrial processes, and (5) build barriers to reduce salt-water encroachment. Advantages of ground-water reservoirs over conventional types are reduced costs, larger capacities, no evapotranspiration losses, and use of large aquifers as distribution systems. A review is given of advances, problems, and the scope of artificial recharge and related operations in Israel, Southern Calif, and the High Plains of Tex. Insight into the magnitude and value of some of these aquifer systems can be gained from consideration of the San Joaquin Valley, Calif. A discussion of ground-water recharge on Long Island, N Y, provides knowledge of artificial recharge in urban and suburban coastal areas. (USBR)
W69-00606

4C. Effects on Water OF Man's Non-Water Activities

EROSION FROM SUBURBAN HIGHWAY CONSTRUCTION,
U S Geological Survey.
Raymond B. Vice, George E. Ferguson, and Harold P. Guy.
ASCE Proc, J Hydraul Div, Vol 94, No Hyl, Pap 5742, pp 345-348, Jan 1968. 4 p, 1 tab.

Descriptors: *Erosion, *Accelerated erosion, *Road construction, *Sediment yield.
Identifiers: Erosion effects of roadwork.

The extent of erosion and transportation of earth materials exposed in highway work was studied in a 4.54 sq mi drainage basin in Fairfax County, Virginia, in 1961 and 1964. About 11% of the basin was disturbed. Sediment yield was measured by sampling at gaging stations for 88 storm events representing the overland runoff from 1961-64. The mean concentration of sediment in the flow increased as the flow in a storm increased. Sediment concentrations in midsummer flow were about double these of midwinter flow. Variability of concentration and yield was considerable, depending on exposure and remedial measures. About 179 acres of construction contributed 94% of the 37,000 tons transported from the basin during the 3.4 years of record. About 85% of the total sand eroded and 29% of the silt were redeposited in the basin and did not pass the sampling site. Precipitation was 13% below average; there would have been about 22% more erosion, or 139 tons per acre per year, with average precipitation. That is ten times normal cultivated-land erosion and five hundred times that of pasture or forest. (Knapp-USGS)
W69-00423

GARDNER V RICHMOND COUNTY (INNUNDATION OF PRIVATE LANDS).

101 Ga App 261 113 S E 2d 411-412 (Ct App 1960).

Descriptors: *Floods, Georgia, *Compensation, Legal aspects, State government, Legislation.

The action was to recover damages to the plaintiff's property caused by flooding and ponding of water on his property due to certain acts of the Highway Department in improving a road. The trial court sustained demurrers to the petition because it was served on the Highway Department rather than the county. The court held that the plaintiff had a right under the constitutional provision requiring adequate compensation for property taken or damaged for a public purpose and that Ga Code no. 95-1710 provides a method for bringing suit against the state. The plaintiff's petition was correct and the demurrer should have been denied. (Horner-Fla)
W69-00480

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KELLER V STATE (LIABILITY FOR FLOODING).
19 Misc 2d 794; 194 NYS 2d 358-366 (1959).

Descriptors: New York, Damages, Civil law, Community development, Eminent domain, Judicial decisions, Natural flow doctrine, Right-of-way, State governments, Water law, *Flood damage, *Negligent inundation, Overflow, Flooding, Culverts, *Embankments, Roadbanks, Highway drainage.

The defendant constructed a fourteen-foot embankment along its highway right-of-way that of necessity cut across the natural drainage of many lands, and caused flooding thereon. To remedy this situation, defendant then installed a culvert. The culvert did not alleviate the problem because it was installed in a negligent manner. The court held that recovery could be had by a landowner for damage resulting from public improvements effected under legislative authority if the damage is shown to be a proximate result of defendant's negligence; (This liability may be extended where the chain of causation extends to land not contiguous to property directly taken for aforesaid public improvement.) The claimant was held to have proven the defendant's negligence and was awarded damages for flooding of his land, as was an owner of land that was not contiguous to the property actually taken for the public improvement. (S. Scott-Fla)
W69-00487

BODICK V HARCLIFF MINING CO (OBSTRUCTION TO STREAMFLOW BY MINING WASTES).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00534

ALLEN V MORRIS BUILDING CO (SURFACE RUNOFF DAMAGE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00541

SHEEHAN V RICHMOND COUNTY (EMINENT DOMAIN AND HIGHWAY DRAINAGE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00547

4D. Watershed Protection

WATERSHED PROTECTION AND FLOOD PREVENTION.
16 USCA Secs 1001-1008 (1964).

Descriptors: *Water conservation, *Watershed management, *Flood control, *Water resources development, Water resources, Projects, Water utilization, Water policy, Cost sharing, Benefits, Federal government, State governments, Local governments, Legislation, Cost-benefit analysis, Water districts, Drainages, Multiple-purpose projects.

The act sets up a program whereby federal assistance may be rendered to any state, political subdivision of a state, or any district with authority to maintain and separate flood prevention or conservation projects. The purpose of the assistance is to cooperate with local governments in preventing erosion, flood water and sediment damages in the watersheds of the rivers and streams of the United States; and in furthering the conservation, development, utilization, and disposal of water and thereby preserving and protecting the nation's land and water resources. The Secretary of Agriculture is authorized to assist local organizations in preparing and carrying out plans for flood prevention or the conservation, development, utilization and disposal of water in watershed or subwatershed areas. The local organizations must supply the land for the project and pay its proportionate share as determined by the Secretary. However, the Secretary is impowered to make federal loans to finance the local costs. (Horner-Fla)
W69-00500

WATER POLICY ON RANGE AND FOREST LANDS,
Karl S. Landstrom.
J Farm Econ, Vol 34, No 5, pp 747-750, Dec 1952. 4 p.

Descriptors: *Watershed management, *River basin development, *Water conservation, Erosion control, Forest management, Sediment yield, Surface runoff, Watersheds (Basins), Forestry, River basins, Runoff, Mountains, Federal government, Water resources, River basin commissions, Sediment control, Missouri, Wildlife, Recreation.

An essential function of range and forest land is to safeguard watersheds and their water supplies. The president's Water Resources Policy Commission recommended a 9 point policy. Soil and forest conservation should occupy a major place in river basin programs. Federal farm and water resources policies should support conservation. The work of watershed management agencies should be coordinated into a single program for each basin and for the country. Techniques are required to measure accomplishments and to estimate the size of the task. Watersheds should be protected by curtailing improper uses of watershed lands. Federal mining laws need revision to provide development of nonmineral resources on mining claims. Expenditure for watershed management should increase in line with expended water developments, and conservation practices on private land should be enforced. There should be public acquisition of areas not suited to private conservation. Participation of operators and the public should increase in watershed management. (Rives-Fla)
W69-00527

EROSION OF COHESIVE SEDIMENTS,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 02J.
For abstract, see .
W69-00608

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification OF Pollutants

CO-OXIDATION OF ORGANIC MOLECULES BY METHANE-OXIDIZING BACTERIA GROWING AT THE EXPENSE OF METHANE,
Illinois Univ, Urbana.
For primary bibliographic entry see Field 02K.
For abstract, see .
W69-00407

ISOTOPIC ANALYSIS OF URANIUM IN NATURAL WATERS BY ALPHA SPECTROMETRY,
U S Geological Survey, Water Resources Division.
Kenneth W. Edwards.
U S Geol Surv Water-Supply Pap 1696-F, pp F1-F26, 1968. 26 p, 6 fig, 8 tab, 24 ref.

Descriptors: *Analytical techniques, *Uranium radioisotopes, *Radiochemical analysis, Ion exchange, Radioactivity, Spectrometers.
Identifiers: *Alpha spectrometry.

A method is described for the determination of U-234/U-238 activity ratios for uranium present in natural waters. The uranium is coprecipitated from solution with aluminum phosphate, extracted into ethyl acetate, further purified by ion exchange, and finally electroplated on a titanium disc for counting. The individual isotopes are determined by measurement of the alpha-particle energy spectrum using a high resolution low-background alpha spectrometer. Overall chemical recovery of about 90% and a counting efficiency of 25% allow analyses of water samples containing as little as 0.10 microgram/l of uranium. The accuracy of the method is limited, on most samples, primarily by counting statistics. (Knapp-USGS)
W69-00425

LINDANE ADSORPTION BY LAKE SEDIMENTS,
Wisconsin Univ., Madison.
Erik G. Lotse, Gordon Chesters Graetz, and Gerhard B. Lee.
Water Resources Center Rpt, July 25, 1967. 42 p, 10 fig, 10 tab, 5 ref. OWRR Project B-008-Wis.

Descriptors: Adsorption, Pesticide kinetics, *Insecticides, Bottom sediments, Lake soils, Radiochemical analysis, Organic matter, Bonding, Clay minerals, Particle size.
Identifiers: Chlorinated hydrocarbons, Multiple regression, Lindane.

Lindane (gamma isomer of benzene hexochloride) adsorption was determined on eight intact lake sediments using a radiochemical technique. Lindane adsorption was shown to be affected by sediment suspension concentration, organic matter content, lindane concentration, clay content and lindane-sediment ratio and to obey Freundlich's equation. As the lindane molecule is neutral and not subject to ionization, van der Waals forces and hydrogen bonding were considered the most feasible adsorption mechanisms. The chlorine atoms of lindane are the most likely bonding sites to hydroxyl groups residing on the surfaces of the organic and mineral components of the sediments.
W69-00621

FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-II. INFLUENCE OF HYDRONIUM ION CONCENTRATION ON ABSORPTIVITY,
Rutgers Univ., New Brunswick, N. J.
Samuel D. Faust, and Edward W. Midulewicz.
Water Res, 1, 509-522, 1967. 29 p, 3 fig, 10 tab, 11 ref. OWRR Project A-012-NJ.

Descriptors: *Phenols, *Organic compounds, Industrial wastes, Water pollution, *Water pollution effects, Water pollution sources, Water quality, Chemical analysis, Chemical properties, Chemical reactions, *Analytical techniques, Data collections.
Identifiers: Halogenated phenols.

The oxidative coupling of 4-aminoantipyrine with several phenolic compounds has been examined with pH values of 8.0 and 10.0. The pH value influences this attack in two ways: (a) greater reactivity is observed at pH 8.0 as the phenol exhibits greater dissociation to a phenoxide ion, and (b) lesser reactivity is observed at pH 10.0 that is ascribed to a reduction of the electrophilic characteristics of the 4-AAP. This hypothesis was tested through a program to systematically sample 17 sites in 5 river systems of northeastern New Jersey and to examine these samples for phenol. In 84 of 153 split samples a reaction pH of 8.0 yielded higher phenol contents than the reaction pH of 10.0. In addition, 44 of these 84 samples were cases where negligible phenol contents were reported at the reaction pH of 10.0. The significance lies in the greater detectability (i.e., analytical sensitivity) of 4-AAP toward phenolic compounds at pH 8.0 than at pH 10.0. (Author)
W69-00622

REDUCING THE POLLUTION BURDEN OF FOOD PROCESSING PLANT WASTES,
California Univ., Davis.
George K. York, and Samuel A. Hart.

OWRR Project A-017-Cal. Water Resour Center Rept, Jan 1967. 25 p, 8 tab, 368 ref.

Descriptors: Bibliographies, Water quality, Water pollution, *Water pollution sources, Water pollution effects, *Waste water (Pollution), Wastes, Biochemical oxygen demand, Canneries, Foods, Nitrogen, Water pollution sources, Hydrogen ion concentration, Phosphates, Sulfates, Chlorides, California, *Industrial wastes.
Identifiers: Meat processing industry, Sacramento Valley, Calif, San Joaquin Valley, Calif.

Pollution burden parameters were measured in waste water from 3 tomato canneries, a frozen vegetable plant, a slaughter house, a cucumber pickle plant, and a winery and distillery located in the Sacrament and San Joaquin Valleys of California. The parameters were flow rate, concentration of solids, 5- and 20-day BOD, hydrogen ion concentration, total nitrogen, phosphates, chloride, and sulfates.
W69-00640

FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE--PART I--A CRITIQUE,
Rutgers Univ. Water Resources Research Inst.
Samuel D. Faust, and Edward W. Mikulewicz.
Rutgers State Univ Rept, 1967. 30 p, 4 fig, 12 tab, 16 ref. OWRR Project A-012-NJ.

Descriptors: Water supplies, Water analysis, pH, Phenology, Phenols, Waste water, Oxidation, Chemical analysis, Chemical reactions, Water quality.

Quantitative determination of phenols in water and waste water is attempted by condensation with 4-aminoantipyrine and oxidation under alkaline conditions to a colored product. Major chemical factors that influence this reaction are pH value between 8.0 and 11.0, the type of aqueous buffer, and the type of substituted phenol. These 3 factors influence the analytical and molecular sensitivities as well as the wave length of maximum absorbance. A total phenol determination is not possible with the 4-aminoantipyrine technique as currently practiced.
W69-00645

5B. Sources of Pollution

ANALYSIS OF WATER QUALITY OF THE MAHONING RIVER IN OHIO,
U S Geological Survey.
Gene A. Bednar, Charles R. Collier, and William P. Cross.
U S Geol Surv Water-Supply Pap 1859-C, pp C1-C32, 1968. 32 p, 21 fig, 1 plate, 5 tab, 3 ref.

Descriptors: *Water quality, *Thermal pollution, *Dissolved oxygen, *Dissolved solids, Waste water disposal, Chlorides, Streamflow, Ohio.
Identifiers: *Mahoning River, Iron concentration, Sulfate load.

Certain water-quality characteristics of the Mahoning River, Ohio, were investigated in order to establish water-quality criteria based on hydrologic conditions and water use. Water temperatures at Princetown and Leavittsburg, which ranged from the freezing point to 78 deg F during 1963-1965, were not affected by thermal loading; however, downstream from Leavittsburg, industrial cooling caused critical thermal loading during periods of low streamflow; 104-108 deg F at Lowellville and Struthers. The dissolved-oxygen content was frequently depleted by oxygen-consuming materials and warmed water from industrial and municipal wastes discharged into the river's lower reaches. At Lowellville, the river water had a dissolved-oxygen content of 5 ppm or less for 67% of the time, and 3 ppm or less for 16% of the time; at Leavittsburg and Princetown this was at acceptable levels. The dissolved-solids concentration was 150-450 ppm at Leavittsburg, and 200-650 ppm at Lowellville, where industrial use caused the higher value. Chloride content (42--108 ppm) was acceptable. Sulfate load from waste disposal and acid mine drainage ranged from 28 to 2,420 tons/day, at different times, depending on location. Iron concentrations were frequently over 20 ppm between Leavittsburg and Lowellville. (Llaverias-USGS)
W69-00428

WATER QUALITY CONTROL AND MANAGEMENT, SNAKE RIVER BASIN.
Federal Water Pollution Control Administration.

Fed Water Pollut Contr Admin Report, 72 p, Sept 1968. 12 fig, 33 photo, 12 tab.

Descriptors: *Water quality control, *River basin development, *Pacific Northwest U S, Water Quality Act, Water pollution sources, Water pollution control, Flow control, Waste treatment, Radioactive wastes.
Identifiers: Snake River Basin.

Summarization is made of various studies which have provided the impetus to Federal-State Water pollution control planning in the Snake Basin. Water quality is now impaired for municipal supply, recreation, fish production, and aesthetic enjoyment in many places; pollution problem areas are indicated on a map. Increase in pollution is occurring because of larger waste discharges and because of a complex system of improvements for irrigation and power, which cause low flows, increased temperature, and decreased capacity to assimilate wastes. Fish kills, thermal pollution, bacterial contamination, and aquatic growth are problems which make portions of the river aesthetically offensive. Groundwater in the upper basin is a largely undeveloped resource which must be protected and used to supplement surface water. The low-level radioactive wastes of the National Reactor Testing Station, which overlies the recharge basin of the Snake River aquifer, must be properly managed to protect both groundwater and the river. Specific measures to reduce contamination are listed. Water resource development data, waste sources, treatment, quality criteria, and other topics are presented in tables and graphs. (Knapp-USGS)
W69-00438

STEBBINS V ORANGEBURG MFG CO (STREAM POLLUTION).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00536

NORTH DADE WATER CO V ADKEN LAND CO (ENJOINING LAKE POLLUTION).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00561

AN EVALUATION OF THE USE OF ESCHERICHIA COLI SEROTYPES AS A MEANS OF TRACING MICROBIAL POLLUTION OF WATER,
Pennsylvania State Univ., University Park.
Paul J. Glantz, and Thomas M. Jacks.
Inst Res Land and Water Resour Rept 1967. 57 p, 8 fig, 11 tab, 25 ref, 2 append, disc. OWRR Project A-008-Pa.

Descriptors: *Water pollution, *Pollution abatement, Sewage, Sewage treatment, *Tracers, Bacteria, *E. Coli, Coliforms, Microorganisms, Sewage bacteria, Effluents.

Utilization of E. coli serotypes as a means of tracing microbial pollution in water was studied. Objectives of the study were: (1) to evaluate the significance of the survival of coliform bacteria and Escherichia coli serotypes in effluent; (2) to determine influence of effluent on the occurrence of coliform bacteria in birds in the spray area; and (3) use of coliform density for determining microbiologic purity of waste water. Results showed that in chlorinated effluent, members of the Klebsiella-Aerobacter group outnumbered E. coli by a ratio of 9:1. Sewage effluent irrigation had no influence on the occurence of coliform bacteria in wild birds and percolation of effluent through soil to a depth of 2-4 ft was sufficient for reclamation of renovated effluent. There was a general rise in fecal coliforms through May to July, declining in August and September. The E. coli serogroups isolated at the different sampling points were an indication of their probable upstream source. Results of this study indicate that tracing microbial pollution by serologically identifying the E. coli strains is feasible.
W69-00625

CHEMICAL REACTOR THEORY APPLIED TO MODELING THE DYNAMICS OF A CONTROL SYSTEM FOR WATER QUALITY OF A RIVER: PHASE 1-A FEASIBILITY STUDY,
Maine Univ., Orono.
Edward G. Bobalek.
Univ Maine Rept., July 1967. 39 p, 8 fig, 5 tab, 2 append, 33 ref. OWRR Project B-001-Me.

Descriptors: Feasibility studies, *Simulation, River systems, Maine, *River regulation, *Water quality, *Estuaries, Water pollution, Saline water-freshwater interfaces, Mixing, Tidal waters, Dispersion, Computer models, *Mathematical models, Fresh water.
Identifiers: Penobscot Estuary, Maine.

The objective of this study was to provide an exploratory appraisal of the feasibility of conducting an extensive experimental probing of a selected river system. Such experiments would have the ultimate goal of providing an accurate and workable model of 1 typical system in the State of Maine. Such a model would be used to implement an overall control scheme which can provide a basis for engineering decisions on regulating waste discharges into the river under conditions which do not overload the capability of the river to purge itself and restore water qualities affected by pollution loading. The Penobscot River estuary was selected as representative of conditions existing in the state with respect to water pollution. The key problem requires prediction of the velocity profile in response to intermixing of tidal and fresh waters. Appraisal of such intermixing correlations is of special importance in determining residence times for pollutants which are nullified by available oxidation and dilution mechanisms. The determination of mixing effects is projected as a primary goal of Phase II which continues this study through acquisition and analysis of data which can permit more precise development of the models here proposed as a starting foundation for the experimental plan.
W69-00642

THE EFFECTS OF TEMPERATURE AND DENSITY GRADIENTS UPON THE MOVEMENT OF CONTAMINANTS IN SATURATED AQUIFERS,
Alabama Univ., University.
Harold R. Henry.
Univ Alabama Rpt, 1967. 14 p, 4 fig, 26 ref. OWRR Project B-004-Ala.

Descriptors: *Contamination, *Aquifers, Convection, *Dispersion, Waste disposal, Thermal properties, Model tests, Saturation zones, Seepage, Numerical method, Laboratory tests, Permeability, Porosity, Porous materials, Bibliographies, Darcys law.
Identifiers: Temperature profiles, Thermal diffusion.

Experimental and analytical studies were made on a simplified geometric model. A horizontal, lateral temperature gradient was imposed upon a horizontal channel of square cross section containing sand saturated with water. Velocities were measured by

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tracing dye patterns along the glass walls and top of the channel. Temperatures were measured by networks of copper-constantan thermocouple junctions spaced throughout the channel. Experimental temperatures and velocities indicated the presence of a convection current which increased in strength as the temperature gradient increased. By defining a stream function psi and by appropriate normalization of the variables, the governing equations were reduced to an expression which is parameter free except for a value, M, which is a modification of the Rayleigh number. Finite difference solutions are obtained for several values of M and for several boundary conditions. The effective value of thermal diffusivity is found to be about 50 times larger than the usual value because of the dispersion which occurs when fluid moves through the tortuous channels within the porous bed.
W69-00651

TRAVEL OF ABS AND AMMONIA NITROGEN WITH PERCOLATING WATER THROUGH SATURATED OAHU SOILS,
Hawaii Univ., Honolulu.
Reginald H. F. Young, L. Stephen Lau, and Nathan C. Burbank.
Water Resour Res Center, Techn Rep 1, Jan 1967. 54 p, 13 fig, 7 tab, 32 ref, 4 append. OWRR Project A-001-Hi.

Descriptors: Percolating water, Infiltration, Detergents, Pollutants, Nitrogen compounds, Soil contamination, Cesspools, Sewage disposal, Groundwater movement, Absorption, Adsorption.

A laboratory study was undertaken to determine the ability of 4 Oahu soils, Lolekaa, Lahaina, Manana, and Wahiawa, to remove ammonia, ABS, and coliforms from water percolating continuously through saturated soils. Soils utilized were chosen on the basis of their wide occurrence on the island areas where percolating water may enter directly and in quantity into the ground water body that principally provides the island's domestic water supply. All 4 soils had a high clay content and low pH. Laboratory tests were conducted with 10-ml burettes and subject to continuous saturated flow. Each contaminant was applied in solution 1 at a time to a fresh soil sample. Tap water was used for ABS and ammonia nitrogen while sewage was used to study coliform removal. The results of coliform removal from percolating liquids were not conclusive because of small soil samples and loading procedures. Preliminary tests verified some general principles developed elsewhere for effective coliform removal by ground disposal of sewage. The final clarifier effluent from a trickling filter was passed continuously through a 30 in. column of Wahiawa soil and an initial coliform reduction of about 90 % was effected.
W69-00652

A SIMPLIFIED PHYSICAL MODEL FOR STUDYING ASSIMILATIVE CAPACITY,
Georgia Inst. of Tech., Atlanta, and Michigan Univ., Ann Arbor.
W. E. Gates, K. H. Mancy, and F. R. Shafie.
Pap, 21st Ind Waste Conf, Purdue Univ, May 1966. 42 p, 17 fig, 27 ref. OWRR Project A-003-Ga.

Descriptors: *Dissolved oxygen, *Water, Water quality, *Oxygen sag, Models, Water analysis, *Oxygenation, Oxygen.

This is a report on the use of a physical model in an attempt to define and evaluate the assimilative capacity of natural waters. Most of these endeavors have utilized dissolved oxygen depletion and/or replenishment as the indicating parameter. Consequently, when dealing with streams, it is generally accepted that the assimilative capacity refers to the oxygen which is available to the biosphere, from or through the hydrosphere, within selected constraints. Because dissolved oxygen content of the hydrosphere is a renewable resource, assimilative capacity is primarily controlled by the rates, the relative rates, and the changes in the rates which dictate the oxygen transfer from the atmosphere to the hydrosphere (surface reoxygenation) and from the hydrosphere to the biosphere (deoxygenation). The physical model described does not permit evaluation of deoxygenation and reoxygenation processes when they are proceeding under identical conditions. The results can be considered only in general terms with respect to other systems, but should be considered as indicative of probable inadequacies in present techniques of assimilative capacity evaluation.
W69-00673

HYDROLOGIC STUDY OF A WASTE-DISPOSAL PROBLEM IN A KARST AREA AT SPRINGFIELD, MISSOURI,
U S Geological Survey, Rolla, Missouri, Water Resources Division.
E. J. Harvey, and John Skelton.
U S Geol Surv Prof Pap 600-C, pp C217-C220, 1968. 4 p, 3 fig, 2 tab.

Descriptors: *Water pollution, *Path of pollutants, *Subsurface drainage, *Karst, Municipal wastes, Sewage effluents, Sinks, Dye release.
Identifiers: *Waste-disposal problem, Seepage runs, Springfield, Missouri.

In a study of a pollution problem in the Springfield area, dye tests, seismic studies, and discharge measurements have proved the existence of a complex naturally developed underground drainage system. Effluent from a sewage plant with secondary treatment travels underground, where it cannot be aerated, and reappears in a downstream spring. Efforts to restrict the effluent to the stream into which it is originally discharged have been only partly successful. Measurements of streamflow and spring discharge show that the natural inflow of water to the spring is large and that it helps to dilute the sewage effluent to a more acceptable level. The primary area of groundwater recharge is agricultural land west of Springfield. Preservation of this area in its present land use and the carrying out of simple corrective measures on the creek carrying the effluent would help alleviate the pollution problem. (Author)
W69-00695

5C. Effects of Pollution

THE EFFECTS OF CLIMATE UPON THE WORK CAPACITY AND CARDIAC AND OPERCULAR CYCLES IN FRESH-WATER FISH,
Massachusetts Univ, Amherst.
John L. Roberts.
OWRR Project A-013-Mass, Proj Completion Rep, Jan 1968. 2 p.

Descriptors: Aquatic animals, *Bioassay, Bullheads, *Climates, Flow, Aquatic environment, *Fish, *Water quality, Physiological ecology, *Thermal stress, Sunfishes, *Swimming, *Temperature, Trout, Ecology, Thermal pollution.

This project investigates sublethal responses by fish to environmental changes that might serve as indexes of water quality. Primarily the study was to describe effects of sustained swimming on heart and ventilation rates of 3 species. The fish chosen were the pumpkinseed sunfish (Lepomis gibbosus); the bullhead, (Ictalurus nebulosus); and the trout (Salmo trutta). Cardioacceleration and increases in ventilation rates were found to occur with enforced swimming in all species. In trout, gill ventilation frequency, but not cardiac frequency, was found to relate in a direct proportionality to swimming speed. Flow velocity of water past the head does not significantly alter the resting pattern of ventilation as does swimming. The secondary aim has been to test selected indexes (cardiac and opercular frequencies). Rapid warming was selected as the index and preliminary testing and recording of these events was tried with goldfish, (Carassiums auratus). The results were unsatisfactory but subsequent experiments at Bristol, England, have shown these 2 rate activities to be highly sensitive indexes of sublethal thermal stress.
W69-00416

WATER TEMPERATURE CRITERIA TO PROTECT AQUATIC LIFE,
Maryland Univ, Natural Resources Institute, Solomons.
J. A. Mihursky, and V. S. Kennedy.
Natur Resour Inst, Contrib 317, Reprint, Amer Fisheries Soc Publ 4, pp 20-32, 1967. 13 p, 11 fig, 43 ref. OWRR Project A-002-Md.

Descriptors: Animal metabolism, Animal behavior, Aquatic animals, *Aquatic life, Estuaries, Fish, Mortality, *Temperature, Temperature control, Thermal pollution, Regulation, Water pollution, Water quality, Water pollution sources, *Aquatic environment.

The ecological significance of temperature in the aquatic habitat is discussed in relation to the thermal loading of ecosystems by electric power plants. It is pointed out that nuclear plants will produce greater amounts of waste heat per kilowatt of electricity than the conventional fossil fuel plants. Effects of temperature on behavior, metabolism, and mortality of aquatic organisms are described to indicate the difficult problems involved in determining acceptable standards for a healthy fish population. A multivariate analysis of interactions between temperature and other environmental factors is suggested. Standards for temperature regulation are described for three ecosystems: (1) cold-water salmonid streams, (2) warm-water centrarchid environments, and (3) estuaries.
W69-00418

ROLE OF NEMATODES AND RELATED MEIOFAUNA AFFECTING FRESH WATER QUALITY IN RHODE ISLAND,
Rhode Island Univ, Kingston.
G. J. Stressel.
OWRR Proj No B-003-RI, Completion Rep, July 1968. 9 p, 2 tab.

Descriptors: *Aquatic microbiology, *Nematodes, *Indicators, *Water pollution, Rhode Island, Water pollution effects, Water Resources Research Act.
Identifiers: *Meiofauna.

Sediment cores, overlying water samples, and samples of the meiofauna of Hunt River, Rhode Island, were taken at seven stations above and below sources of pollution to determine the relationships between fauna and pollution. Physicochemical measurements were made concurrently with sampling. Maximum nematode populations occurred in winter and spring when water temperature was about 8 deg C. Predaceous nematodes were more numerous when organic matter was over 12%. Dissolved oxygen, phosphate, and carbon dioxide concentrations and nematode or meiofaunal populations could not be correlated. Population dynamics at polluted and unpolluted sites were similar, but the predaceous nematode genus Monochus occurred only at polluted sites; it is a promising pollution indicator. (Knapp-USGS)
W69-00427

PLANKTONIC PHOTOSYNTHESIS AND THE ENVIRONMENT OF CALCIUM CARBONATE DEPOSITION IN LAKES,
Minnesota Univ., Minneapolis, Limnological Res Center.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-00446

WATER QUALITY ALTERATION THROUGH ACID AND HEAT POLLUTION IN A 150 ACRE RESERVOIR,
Missouri Univ., Columbia, Water Resour Re Center.
Robert S. Campbell, James. R. Whitley, and Edward R. Brezina.
Proj Rep 1, Univ Mo, Mar 1966. 33 p, 8 fig, 9 tab, ref. OWRR Proj A-004-Mo.

Descriptors: Water quality, *Water pollution, Turbidity, Heated water, Mine acids, Fly ash, Plankton, Aquatic life, Alkalinity, pH, Animals, *Fishkill, Acidity, Hydrogen ion concentration, *Thermal pollution, Industrial wastes.

An investigation was made to evaluate the influence of several effluents on water quality, the biota, and the autotrophic aspects of community metabolism. Certain physical and chemical conditions vary throughout the reservoir in a pattern related to the site of hot water discharge. The most conspicuous environmental variant is water temperature, which ranges from 37 deg C at the steam plant discharge canal to 21 deg C at the western end of the lake. Dissolved oxygen range was 0.2 to 11.0 ppm, with the lower values from the deeper more stagnant water at the eastern and western ends of the lake. No evidence was found of alkaline drainage into the reservoir. At the time of reported fish kills, 1962-63, fly ash was piled adjacent to the reservoir. Fly ash is now stored in bins protected from the weather. Preliminary inspection of the plankton and bottom fauna suggests that the fauna is not rich.
W69-00450

PLANKTON HETEROTROPHY IN A NORTH CAROLINA ESTUARY,
North Carolina Univ., Raleigh, Water Resour. Res. Inst.
John E. Hobbie.
Proj Completion Rep, Univ N Car, Nov 1966. 9 p, 2 fig, 1 tab, 9 ref. OWRR Proj A-015-NC.

Descriptors: *Plankton, Indicators, *Eutrophication, Domestic wastes, Phosphates, *Effluents, *Bacteria, Radioactivity techniques, *Estuarine environment.

The heterotrophic ability of the bacteria of the plankton was studied utilizing uptake of radioactive organic compounds. The method was developed in fresh water, but proved to be adaptable to estuarine conditions. This project, the first phase of a larger study of bacteria in the aquatic ecosystem, found that glucose and acetate were taken up by bacterial uptake systems and that the uptake rate could be analyzed by the equations of enzyme kinetics. The maximum uptake velocity was a good indication of relative heterotrophic activity, and reached a peak during the summer in the Pamlico River estuary. This parameter was a rapid and sensitive indicator of eutrophication as peaks of activity found in a 30-km survey were correlated with domestic wastes and effluent from phosphate mining activity.
W69-00456

GAME AND FRESH WATER FISH - CONTAMINATING FRESH WATERS.
Fla Stat Sec 372.85 (1967).

Descriptors: *Florida, *Legislation, Water law, Legal aspects, Water pollution, *Pollution abatement, Water pollution sources, Mine water, Sawmills, State governments, Water pollution effects, Fish populations, Fish conservation.

Florida Statute section 372.85 declares that it shall be unlawful for any person or persons, firm or corporation to cause any dye-stuff, coal tar, oil, sawdust, poison or deleterious substances to be thrown, run or drained into any of the fresh running waters in quantities sufficient to injure, stupefy, or kill fish which may inhabit the same at or below the point where any such substances are discharged; provided, that it shall not be a violation of this section for any person, firm or corporation engaged in any mining industry to cause any water handled or used in any branch of such industry to be discharged on the surface of land where such industry or branch thereof is being carried on under such precautionary measures as shall be approved by the game and fresh water fish commission. (R. Smith-Fla)
W69-00510

ADAIR V FRISBY (DAMAGES FROM SALT WATER DISCHARGE).
State of Arkansas, Little Rock.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00558

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
Water Resources Engineers, Walnut Creek, Calif; Washington Univ, Seattle.
Denny S. Parker, and James A. Crutchfield.
Water Resour Res, Vol 4, No 2, pp 233-246, Apr 1968. 14 p, 9 fig, 2 tab, 6 ref.

Descriptors: Project feasibility, Project planning, *Water pollution, Water development, Water quality, Water requirements, Water management, Water resources, Water utilization, Waste disposal, Pollution abatement, Economics, *Benefit-cost ratios, Public works, Time, Costs, Benefits, *Social values.
Identifiers: Waste water (Pollution), Waste management, *Cost-benefit analysis, Water resources development, Long-term planning.

Economic evaluation of pollution-causing water projects cannot neglect social costs of water pollution, i.e., the net loss of benefits from an alternative use if the water was not used for waste disposal. Planners have often been concerned only with conveying wastes out of their jurisdiction, choosing the most expedient solution. The resulting long-term social costs are often sufficiently large that a different system would have been selected if social costs had been considered initially. The valuation of benefits and costs from major public projects requires long-term forecasts. Long-term social costs cannot be neglected nor ignored when there are demands for amenity services of water. If social costs of water pollution were adequately evaluated, a higher level of investment might be justified for waste management. The obligation to future generations may have a sound economic basis for maintaining higher levels of water quality than can be justified by current benefit-cost practices. (USBR)
W69-00582

BIOCHEMICAL CAPABILITIES OF SURFACE FILMING BENTHIC BACTERIA IN FRESH WATER SYSTEMS,
Missouri Univ., Kansas City.
Russell G. Barnekow, Jr., and Edward L. Davis.
Water Resour Res Center Rept 2, Jan 1967. 24 p, 6 plates, 1 tab, 15 ref. OWRR Project A-005-Mo.

Descriptors: *Bacteria, *Aerobic bacteria, Pseudomonas, Oil wastes, Mycobacterium, *Oxidation lagoons, Biodegradation, Industrial wastes, Waste treatment, Organic matter, Sulfur bacteria, Tertiary treatment, *Cultures.

Utilization of glucose and sorbitol by large, heterogeneous bacterial populations obtained from a petro-chemical oxidation lagoon was examined. Two population types were observed: one which used glucose and sorbitol with no lag period and another which exhibited an extended lag period before substrate utilization was detected. Simultaneous utilization of glucose and sorbitol by populations which did not exhibit a lag period was observed. The extended lag period shown in other populations was attributed to preferential use of endogenous materials. These populations also demonstrated adaptation to exogenous substrates. The populations examined were primarily composed on non-fastidious, oxidative aerobes.
W69-00624

BIOTIC RESPONSE TO POLLUTION REDUCTION IN A RIVER,
Michigan State Univ., East Lansing.
Allen W. Knight, and George H. Lauff.
W K Kellogg Biology Sta Rep, 1967. 56 p, 10 fig, 16 tab, 14 ref. OWRR Project A-010-Mich.

Descriptors: *Stream pollution, *Pollution abatement, Rivers, Water pollution control, Sludge worms, Sludge, Aquatic life, Lake Michigan, Dissolved oxygen.

A study of the Kalamazoo River was conducted to ascertain conditions existing prior to initiation of a pollution abatement program. The river was found to be grossly polluted in a 20-mi stretch below the city of Kalamazoo. Decomposition of organic matter in water and in extensive silt accumulations frequently depleted the dissolved oxygen for 20 mi or more. Sewage fungus covered the surface of sludge deposits and stationary objects in the water while extensive numbers of sludge worms frequently occurred as red fringe along the river margins. Only a few of the more tolerant macroinvertebrates and fish occurred in the very polluted zone. In lower reaches of the river considerable self-purification was accomplished and a return of many of the macroinvertebrates and game fish was noted. The river prior to its discharge into Lake Michigan has accomplished considerable self-purification but carried a large load of suspended and dissolved materials into Lake Michigan.
W69-00631

LIMNOLOGY, PRIMARY PRODUCTIVITY, AND CARBONATE SEDIMENTATION OF MINNESOTA LAKES,
Minnesota Univ.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-00632

SURVEY OF THE NATURE AND MAGNITUDE OF THE WATER RESEARCH NEEDS OF THE TEXTILE INDUSTRY OF GEORGIA,
Georgia Institute of Technology, Atlanta.
William L. Hyden, Douglas F. Becknell, and Telford E. Elders.
OWRR Project A-010-Ga. Water Resour Center Rept, June 1966. 27 p, 1 photo, 1 map, 2 append.

Descriptors: *Textiles, *Industries, Industrial wastes, Waste water disposal, *Water pollution control, pH, Effluents, Water chemistry, Waste water treatment, Water reuse, Georgia, Water temperature, Water pollution sources, *Water pollution.
Identifiers: Water use, *Textile industry.

The investigation described herein, consisted of a field survey of 48 representative wet-processing textile mills in the state of Georgia to determine the kinds and frequency of occurrence of serious problems related to water use and waste disposal. From data obtained from plant inspections and interviews, 12 different problems were found to occur at 3 or more of the 48 mills. Excessive hardness of the raw water supply was experienced at 17 mills. Miscellaneous problems of wastewater disposal were found at 11 mills. Analysis of survey results, supported by consultation with industry leaders and experts in sanitary engineering and water chemistry, led to the conclusion that some of the most common problems were subject to solution by known techniques. Others, that occurred less frequently, are problems with no known technically or economically feasible solution. Outstanding is the problem of excessive color in wastewater effluent. A brief discussion includes the 12 most frequently encountered problems. Possible solutions and recommendations regarding research are suggested, among these development of more efficient processing equipment and management techniques.
W69-00639

ENHANCEMENT OF RECREATIONAL USES OF ESTUARINE WATERS THROUGH STUDY OF POTENTIAL CONTROL METHODS FOR STINGING SEA NETTLES,
Maryland Univ., College Park.
David G. Cargo.
Natur Resour Inst Prog Rpt, Dec 1966. 26 p, 5 plate, 3 tab, 14 ref, disc. OWRR Project B-001-Md, B-002-Md.

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Descriptors: *Foods, Laboratory tests, Field tests, Water, Biology, Research and development, Water, Temperature, Seasons, Zoology, *Sea nettles, Preditation, Spawning.
Identifiers: *Polyps, *Nudibranch, Medusa.

A number of laboratory and field oriented experiments and observations are described. Temperature tolerance of polyps of the sea nettle showed that they encyst at 4 C. Most polyps set on the undersides of substrates. Predation upon polyps by the nudibranch Coryphella pellucida is revealed. Observations on the winter jelly fish showed that this species is seasonally opposite to the summer nettle and has all the same stages. Growth of medusae, variation in seasonal abundance and setting patterns of planula larvae were examined. Maximum growth observed was from 3 to 170 mm in 33 days. Peaks of abundance and spawning take place in late July and early August. A laboratory experiment showed that the ctenophore is an acceptable and nutritious food for sea nettles.
W69-00647

SURFACE-WATER CHEMISTRY OF SOME MINNESOTA LAKES, WITH PRELIMINARY NOTES ON DIATOMS,
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-00659

5D. Waste Treatment Processes

OPTIMAL AERATION SYSTEMS,
Kansas State University, Manhattan.
L. E. Erickson.
Kansas Water Resour Res Inst, Proj Completion Rep, Kansas State Univ, Aug 1967. 41 p, 14 fig, 3 tab, 22 ref, 2 append. OWRR Project B-001-Kann.

Descriptors: Biological treatment, *Activated sludge, *Aeration, Mixing, Hydraulic models, *Mathematical models, *Optimization, Analysis design.

The pattern of flow into the system, the recycle flow, and the mixing within the system are important parts of the hydraulic regime of activated sludge systems. Optimization procedures are used to determine the optimum hydraulic regime for several activated sludge systems. Mathematical models of several step aeration systems are developed and a discrete version of the maximum principle is used to optimize the hydraulic regime in these step aeration systems. The results of this research indicate that the constant K sub 1, which is the dimensionless organic nutrient concentration at which the observed specific growth rate is one-half the maximum value, is an important parameter in selecting the optimal hydraulic regime. This research illustrates some of the uses of mathematical modeling and optimization in the analysis and design of biological waste treatment systems.
W69-00408

OPERATING CHARACTERISTICS OF TWO AEROBIC-ANAEROBIC DAIRY MANURE TREATMENT SYSTEMS,
New Holland Machine Co, New Holland, Pa and Massachusetts Univ, Amherst.
N. W. Webster, and J. T. Clayton.
OWRR Project A-009-Mass, Mange Farm Animal Wastes, Amer Soc Agr Eng, St. Joseph, Mich, pp 61-65, 1966. 5 p, 14 fig, 2 tab, 20 ref.

Descriptors: Waste disposal, *Waste treatment, *Farm wastes, *Cattle, *Aerobic bacteria, *Anaerobic bacteria, Operations, Settling basins, Dairy industry, Biochemical oxygen demand.

Two aerobic waste-treatment systems were designed and tested for use in treating dairy manure. The systems were combinations of aeration and settlement for the purpose of reducing the pollution capabilities of the waste and to make possible the use of treated effluent for transporting fresh waste. The designed systems were first tested on a bench-scale system, and results showed that the loadings were too heavy. The loadings were reduced to 0.044 lb of volatile solids per system and rerun. The second test was satisfactory and loadings and containers were scaled up 100 times to 4.4 lb of volatile solids per system with tank sizes of 1000, 750, 500, and 300 gal. This pilot model was run for 5 months before it was terminated. System A, the anaerobic primary settlement and secondary aeration system was functioning and could have been continued. System B, primary aeration with secondary settlement, did not operate satisfactorily for the full 5-month test period. The system suited for agricultural uses was System A, with the addition of a small sediment tank with provisions for returning the settled solids to the primary settlement tank. This added feature would prevent an anaerobic condition from developing in the final sedimentation tank.
W69-00413

EFFECT OF NITRIFICATION OF ORGANIC WASTES ON WATERS IN THE NATURAL ENVIRONMENT,
Maine Univ, Orono.
K. Keshavan.
Water Resour Center Proj Completion Rep, June 1967. 56 p, 37 fig, 7 tab, 18 ref. OWRR Project A-003-Me.

Descriptors: Nitrification, Chemical reactions, Nitrates, Nitrites, Biochemical oxygen demand, Dissolved oxygen, Water purification, Water quality.

It is currently recognized that the biochemical oxygen demand of streams, estuaries and lakes can not always be reliably determined from data obtained in the laboratory. This is because nitrification is suppressed in these laboratory tests. Nitrification and oxidation of carbonaceous organic compounds occurring concurrently in natural bodies of water will utilize more oxygen than predicted by the oxygen sag curve. As a result, such practices as the classification of streams may be based upon erroneous BOD information. This research has shown that nitrification (oxidation of ammonia by nitrifying bacteria) becomes very significant in the presence of an active flora of nitrifying bacteria. It is more pronounced if the waste contains nitrogenous materials such as proteins and similar compounds. These compounds can be expected in wastes from starch plants, meatpacking plants and many other industries. The research has also shown that if the stream or lake is on the alkaline side (pH greater than 7.5), a further increase in the activity of the nitrifying bacteria can be expected. It is therefore, very important to consider the natural conditions of the receiving body of water before an evaluation of the oxygen resource is made.
W69-00419

THE EFFECT OF ELEVATED TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE,
Mississippi State Univ., State College, Water Resour Res Inst.
Lewis R. Brown, Robert G. Tischer, and Cornell M. Ladner.
Miss State Univ, June 1967. 55 p, 26 fig, 6 tab, 5 ref. OWRR Proj A-007-Miss.

Descriptors: Sewage, Waste treatment, Microbiology, *Microorganisms, *Sewage treatment, Domestic wastes, Temperature, Biochemical oxygen demand, Chemical oxygen demand, *Coliforms.

Studies were conducted at temperatures of 30, 45, 55, and 65 deg C. Suspended solids (90%) removals were the same at all temperatures employed while the settleable solids were reduced 80% in the 30 deg C treatment and 58% in the 55 deg C treatment. BOD reductions (70%) were the same at all temperatures tested while the COD removals decreased with increases in temperature. E. coli, an unidentified enterococcus, and the enteric pathogens Salmonella paratyphi and Shigella sonnei were destroyed 30 minutes at 55 deg C and 10 minutes at 65 deg C. The bacteriophage for E.coli 11033-B was considerably more heat stable but was inactivated at 55 deg C by 80.3, 97.9, and 99.9% in sewage, distilled water, and nutrient broth, respectively. There were 1000 facultative thermophiles per ml in the sewage employed. The population growing at temperature of aeration reached 100 million organisms per ml for the 30, 45, and 55 deg C treatment and 10 million organisms per ml for the 65 deg treatment. Thermophiles isolated from normal domestic sewage after aeration at 55 deg C were either Pseudomonas aeruginosa (achromogenic strain) or members of the genus Bacillus. Protozoa were extremely effective in reducing the turbidity and COD of the 55 deg treatment effluent.
W69-00449

HIGH-RATE ROTARY VACUUM FILTRATION,
Rutgers Univ., New Brunswick, Water Resour. Res. Inst.
F. W. Dittman.
Rutgers Univ., 1967. 4 p, 1 tab, 3 ref. OWRR Proj A-004-NJ.

Descriptors: Filtration, *Sludge, Filters, *Sludge treatment, Sewage treatment, Sludge disposal, Waste disposal, Calcium carbonate, *Waste treatment.
Identifiers: Filtration rate, Sludge cake.

An economic study of an existing waste treatment plant indicated that sludge filtration might be an acceptable alternative to the existing process of transportation and ocean dumping, if higher than usual filtration rates could be obtained. Study of the several problems of the variation in filtration rate of aqueous calcium carbonate, suspensions gave numerical values for increase in filtration rate which would result from operating a rotary filter at high speed with a very thin cake. Various means of applying energy to the membrane for rapid continuous separation of thin filter cake are discussed.
W69-00455

RECOVERY OF WARP SIZES,
North Carolina Univ., Chapel Hill, Water Resour. Res. Inst.
Harley Y. Jennings.
Univ N Car, Proj Completion Rep, June 1966. 2 p. OWRR Proj A-016-NC.

Descriptors: *Water pollution control, *Water pollution sources, *Water reuse, *Industrial wastes, Liquid wastes.
Identifiers: *Textile industry.

One phase of study included a search of the literature and preparation of annotated bibliography covering 297 papers on textile wastes. The second phase included an exploratory investigation of the recovery and reuse of textile size materials. Carboxymethylcellulose (CMC) was dissolved from cotton warp with minimal amounts of water and the resulting solution used as the basis for further sizing formulation. Experiments disclosed that one-third of applied CMC could be removed from the sized warp obtaining a 2 percent solution. New formulations prepared from this solution gave satisfactory performance. Warps passed through boiling water to remove waxes and pectins containing 70 percent moisture picked up sufficient CMC from formulation to perform satisfactorily on testing equipment.
W69-00457

VERMONT WOOLEN CORP V WACKERMAN (WATER POLLUTION ABATEMENT).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00554

ENZYMES AND CATALYSTS FOR PURIFICATION OF INDUSTRIAL WASTE WATER,
Oklahoma State Univ., Stillwater.
James W. Fulton.
Water Resour Inst, Oklahoma State Univ, June 1966. 37 p, 70 ref, append. OWRR Project A-007-Okla.

Descriptors: *Organic compounds, *Water purification, *Enzymes, Phenols, Chemical reactions, Chemical wastes, Industrial wastes, Catalysts.

The purpose of this study is to initiate research in the use of catalyst and enzyme systems for industrial waste-water purification. Records have been assembled on the known undesirable waste-water impurities. The literature has been searched for enzyme and bacteria systems which are known to decompose toxic materials. The decomposition of phenolic compounds has been emphasized, as an example. Suggestions for further research have been given.
W69-00619

THE EFFECT OF ELEVATED TEMPERATURES ON THE MICROFLORA OF NORMAL DOMESTIC SEWAGE,
Mississippi State Univ., State College.
Lewis R. Brown, Robert G. Tischer, and Cornell M. Ladner.
Water Resour Res Inst Rept, July 1966. 20 p, 3 tab, 3 ref. OWRR Project A-007-Miss.

Descriptors: *Microorganisms, *Sewage treatment, *Domestic wastes, Sewage, Temperature, Biochemical oxygen demand, Coliforms, Aeration, Chemical oxygen demand, Waste treatment.

Treatment of normal domestic sewage at elevated temperatures destroyed the enterococcal and coliform populations nearly completely at 65 deg C and is only slightly less effective at 55 deg C. The enteric pathogens, Salmonella paratyphi and Shigella sonnei, are destroyed within minutes at these elevated temperatures. The effluent from a high-temperature sewage stabilization process will not need chlorination. Approximately 100,000 facultative thermophiles/ml appear capable of growing at 55 deg C in the normal domestic sewage employed in these studies, sine thermophilic count at 55 deg C remained about 100 thousand ml when treatment temperature was 30 deg C and the mesophilic count at 30 C remained 100 thousand/ml microorganisms (or dropped off to about 100 thousand) when the treatment temperature was 55 deg C. More organisms appear in normal domestic sewage that grow at 45 deg C than there are that grow at 55 deg C or 65 deg C. The 65 deg C temperature appears to be more detrimental to the mesophilic population than the other temperatures employed. The reductions in COD and suspended solids of the influent sewage averaged more than 90% in all cases.
W69-00634

INCREASED GAS TRANSFER IN BIOLOGICAL REACTORS OF INTEREST IN WASTE WATER RECLAMATION,
Delaware Univ., Newark.
Iraj Zandi, and Miriam S. Shane.
Univ. Delaware Rept., June 1967. 24 p, 13 fig. OWRR Project A-001-Del.

Descriptors: *Activated sludge, *Biodegredation, Sludge treatment, Sludge digestion, Chemical reactions, Sewage treatment, Microorganisms, E. coli, Aerobic bacteria, Polymers, Gases, Oxygen, *Diffusion, Aqueous solutions, *Diffusion, *Growth rates, Respiration, Cultures.
Identifiers: Aerobacter aerogenes, Bacillus megaterium.

Unit processes in waste water treatment are dependent upon the satisfactory transfer of gases into and out of waste water for biological degradation of the organic matter. Any material that could increase transfer efficiency of gases would be of interest in waste water processes particularly activated sludge treatment. Studies of the diffusion of molecules of low molecular weight (such as gases) through dilute polymer solutions seemed to indicate that the rate of diffusivity was greater in aqueous polymeric solution than in pure solvent (water). The effect of a long chain synthetic polymer was studied in relationship to growth and respiration rates using three test organisms. Growth was measured quantitatively in the presence of different concentrations of polymer and compared to growth in the absence of polymer. A closed system using an electronic dissolved oxygen analyzer capable of measuring oxygen in parts-per-billion was used to study respiration rates in the presence of polymer.
W69-00646

ELECTRODIALYSIS IN ADVANCED WASTE TREATMENT,
U S Department of the Interior, Federal Water Pollution Control Administration.
J. Douglas Smith, and John L. Eisenmann.
Water Pollut Contr Res Ser Pub No WP-20-AWTR-18, 219 p, Feb 1967. 32 fig, 28 tab, 19 ref, 5 append.

Descriptors: *Tertiary treatment, *Electrodialysis, *Laboratory tests, Liquid wastes, Water reuse, Membrane processes, Solvent extractions, Scaling, Cost analysis.
Identifiers: *Advanced waste treatment, Carbon adsorption, Secondary effluent, Deionization.

A bench-scale experimental study was made to determine the practicality of partially demineralizing municipal wastewater by electrodialysis. Using filtration alone and filtration followed by carbon adsorption as pretreatments, long-term runs were made with a municipal secondary effluent to determine scaling and fouling effects of the water upon the electrodialysis membranes. During these runs a study was made to determine how high a ratio of product rate to concentrate rate could be obtained without forming scale on the membranes. Some fouling of anion membranes occurred with filtration and carbon adsorption pretreatment; without carbon adsorption, fouling was much worse. Scale formation was not a problem at product to concentrate ratios less than ten. At times much higher ratios were obtained without difficulty. The results of these runs indicated that the total operating cost for a 10-mgd electrodialysis treatment plant might be less than 10 cents per 1,000 gal. (Knapp-USGS)
W69-00691

5E. Ultimate Disposal of Wastes

CURRENT SEPTIC TANK SYSTEM INSTALLATION PRACTICES IN CONNECTICUT,
Connecticut Univ., Storrs.
J. J. Kolega, W. C. Wheeler, and G. W. Hawkins, Jr.
J Water Pollut Control Federation, Vol 38, No 10, pp 1592-1600, Oct 1966. 9 p, 6 tab, 9 ref. OWRR Project A-001-Conn.

Descriptors: Construction, Installation, *Septic tanks, Housing, Water pollution, Domestic wastes, *Sewage disposal, Sewage, Sewage effluents, Sewage treatment, Standards, Pollution abatement, Sanitary engineering, Soil disposal fields, *Connecticut.

A survey made by the Agricultural Engineering Department at the University of Connecticut of 195 installers of individual household sewage disposal systems evaluates, in terms of the Connecticut State Department of Health Sanitary Code, the domestic sanitation systems being installed in the State. The many inconsistencies which exist points out a need for strengthening of adherence to the State Code. Installation practices are reported and problems cited. Several approaches to strengthening the enforcement of proper sewage sanitation practices are given.
W69-00653

5F. Water Treatment and Quality Alteration

FACTORS AFFECTING THE REMOVAL OF IRON AND MANGANESE FROM GROUND WATER,
Mississippi State Univ., State College, Water Resour Res Inst.
L. R. Robinson, Jr., E. D. Breland, and R. A. Dixon.
Miss State Univ, 1967. 78 p, 5 fig, 23 tab, 22 ref, append. OWRR Proj A-003-Miss.

Descriptors: *Iron, Manganese, Groundwater, Separation techniques, *Water treatment, Waste treatment, Filtration, Alkalinity, Chemical analysis, Mississippi, Alabama, pH.

By using both a pilot treatment plant and a jar test apparatus, studies were made of factors affecting oxidation and precipitation of iron and manganese from ground waters in Mississippi and Alabama. Aeration alone was insufficient to oxidize and remove iron from waters with alkalinities of less than 50 mg/1 as calcium carbonate. Aeration was also insufficient to oxidize and precipitate manganese from ground waters with pH values of less than 9.0. Additional testing indicated that iron could be successfully removed by the processes of aeration, reaction time, and filtration, if the alkalinity was raised to at least 100 mg/1 as calcium carbonate prior to aeration by adding soda ash, lime, or caustic soda. Manganese could also be removed by raising the pH to 9.0 or preferably to 9.5 with lime or caustic soda. Potassium permanganate also successfully oxidized, precipitated, and removed iron and manganese. It presented the additional advantage that it did not greatly affect the water stability and thus necessitate further treatment. It also proved to be the most economical method from a chemical standpoint.
W69-00447

RADIOACTIVE DECONTAMINATION BY SLURRYING WITH YAZOO AND ZILPHA CLAYS,
Mississippi State Univ., State College.
William A. Goldsmith, and E. J. Middlebrooks.
Reprint, J Amer Water Works Ass, Vol 58, No 8, pp 1052-1062, Aug 1966. 11 p, 8 fig, 2 tab, 18 ref. OWRR Proj. A-004-Miss.

Descriptors: Water supply, Radioactivity, Water treatment, *Slurries, Water pollution treatment, Ion exchange, pH, Adsorption, Clays, *Radioactive wastes, Nuclear wastes, *Radioactive waste disposal, Radioisotopes.

The report covers decontamination of radionuclide-polluted waters using clay slurries. The literature on radioisotope removal is briefly reviewed. The paper discusses effect of pH and ion adsorption by clays. Test results are given on removal of Cobolt 60, Strontium 90, and Cesium 137 using Yazoo and Zilpha clays. Zilpha clay was superior to Yazoo as an adsorber of Strontium 90. Both Yazoo and Zilpha clays provided very good removal of Cesium 137, approximately 90% at a dosage of only 250/mg/1. Decontamination factors and percentage removals obtained for clay dosages used, except for Yazoo clay for Strontium 90, exceeded values obtained from comparable experiments involving other clays reported in literature. These encouraging results indicate that Yazoo and Zilpha clays may prove to be economically more feasible than the clays now used commercially.
W69-00448

THE ACCEPTABILITY OF MINERAL TASTE IN DOMESTIC WATER,
California Univ., Berkeley, Public Health Sch.
Andie L. Knutson, and William H. Bruvold.
Water Resour Res Center, Univ Calif, Rep W107-1A-67, July 1967. 10 p, 2 fig, 1 tab, 12 ref. OWRR Project A-005-Cal.

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Descriptors: *Standards, Water quality, *Mineral water, Domestic water, *Potable water, *Taste, Attitudes, Dissolved solids, Consumptive use.

This report describes research designed to recommend limiting standards for common mineral content in domestic water in order to assure potability for daily drinking. A near linear relationship was found to exist between mean consumer attitude taste scale scores and a measure of total dissolved solids for 17 selected California water systems. The line so determined had a negative slope, the higher the total dissolved solids the less favorable the mean attitude scale scores. Use of the information provided by this relationship to recommend the desired standards upon full completion of the project was discussed.
W69-00656

5G. Water Quality Control

THE DISTRIBUTION AND PERSISTENCE OF DIAZINON APPLIED TO PLANT AND SOIL AND ITS INFLUENCE ON RHIZOSPHERE AND SOIL MICROFLORA,
Institute of Agricultural and Industrial Microbiology, Amherst and the Cranberry Experiment Station, East Wareham, Mass.
H. B. Gunner, B. M. Zuckerman, and R. W. Walker.
OWRR Project A-010-Mass, Plant and Soil, Vol 25, No 2, pp 249-264, 1966. 16 p, 5 fig, 4 tab, 10 ref.

Descriptors: *Diazinon, Insecticides, Pesticides, Planta, Rhizosphere, Soil microbiology, Degradation (Decomposition), Translocation.

Evidence was obtained of the rapid translocation of radioactive Diazinon through bean plants and its emergence in bean root exudates maintained under sterile conditions. Diazinon applied at the rate of 3 lbs per acre to soil under non-sterile conditions persisted for as long as 180 days after application. No Diazinon was detectable after 10 wks in soil receiving 0.3 lbs per acre. Diazinon or its degradation products exerted a selective effect common to both soil and rhizosphere microflora which expressed itself in the selective enrichment of a cocoidal rod. After 180 days a large number of the genus Streptomyces appeared as a seeming climax population. The predominant microbial isolate utilized Diazinon as a sulfur, phosphorus, carbon and nitrogen source in that order of preference.
W69-00414

A COST-BENEFIT ANALYSIS OF MINE DRAINAGE,
Ohio State Univ, Columbus.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00426

REPORT OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE, TO ACCOMPANY S 2670, P 12-53.

Federal Water Pollution Control Act Amendments of 1967 -- 90th Congress, 1st Session, Senate Report No 917, Dec 11, 1967. 42p.

Descriptors: *Legislation, *Grants, Acid mine water, Mine wastes, *Oily water, Water pollution, *Lakes, Projects, Research and development, Model studies, Water pollution control.
Identifiers: Demonstration projects.

The Report discusses the major provisions of S 2760, including the reasons for them and their effect. It also includes a section-by-section analysis of the bill. A new and specific demonstration and research program dealing with both natural and man-made lake pollution is authorized. Projects are also authorized which will demonstrate techniques of controlling or eliminating acid or other mine water pollution. Projects demonstrating control or elimination of such pollution are also directed to be undertaken for entire watersheds or drainage areas. Implementation guildlines are set out. The Bill repeals the Oil Pollution Act of 1924, and adds a new section to the FWPCA, incorporating many provisions of the old Oil Pollution Act. The new section removes the necessity that a discharge be 'grossly negligent or willful' to violate the Act, and expands coverage to include shore installations. Persons who discharge oil are required to remove it immediately or pay all costs of clean-up. A revolving fund is established to enable the Secretary to take immediate action to avoid serious oil pollution. The FWPCA, with amendments contained in the Bill, is included. (R. F. Williams-Fla)
W69-00491

REPORT OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE, TO ACCOMPANY S 2760, P 1-11.

Federal Water Pollution Control Act Ammendments of 1967 -- 90th Congress, 1st Session, Senate Report No 917, Dec 11, 1967. 11p.

Descriptors: *Legislation, *Acid mine water, Coal mine wastes, Mine wastes, *Oily water, Water pollution, Political aspects, *Lakes, Project planning, Research and development, Eutrophication, Waste assimilative capacity.

S2760 is an omnibus water pollution bill, which consolidates the provisions of several other bills relating to lake pollution, oil pollution, and drainage pollution from mines, and which amends the Federal Water Pollution Control Act accordingly. The lack of federal legislation concerning lake pollution, special problems of lake pollution, lack of knowledge in this area, and potential solutions are discussed. Since lakes lack the flushing action of running water, their problems differ from those of rivers. Lake eutrophication, or natural deterioration, is accelerated by pollution. Acid and other mine drainage pollution is discussed next. Acid from mines seriously upsets the biological balance in streams and this problem is compounded by the fact that most such pollution comes from abandoned mines. Techniques of abatement of mine drainage pollution are discussed. Oil pollution, and serious cases thereof are next discussed. Oil pollution is usually incedent to the transportation of oil, and is caused by accidents, poor maintenance, carelessness, etc. The Oil Pollution Act of 1924 was found to be inadequate to cover these problems. (R. F. Williams-Fla)
W69-00492

NEW YORK POLLUTION CONTROL POLICY AND LAKE ERIE,
Anselmo F. Dappert.
Industrial Water and Wastes, Vol 9, No 1, pp 29-31, Jan-Feb 1964. 3 p.

Descriptors: New York, *Water pollution control, Neutralization, Sewage treatment, Waste water treatment, *Lake Erie, Taste, Water pollution effects, Acidity, Odor, Domestic wastes, Industrial wastes, Sewage effluents, Silts, Sewage disposal, Legislation, Water law, State governments.

The New York State water pollution control program is based on the concept that all waters which receive or are to receive waste discharges of any kind shall be protected to the extent necessary for the various usages which are officially recognized for such waters. The official recognition of these usages is preceded by a series of steps leading to classification and assignment of quality standards to all waters in the state-fresh surface waters, tidal salt waters and ground waters. Basically, for discharges into Lake Erie waters the policy is to consider each problem in relation to the particular circumstances and the actual or anticipated lake classifications. (R. Smith-Fla)
W69-00495

LEGISLATING CLEAN WATER,
Portia Law School, Beacon Hill, Boston, Mass.
J. R. Flood.
Portia L J, Vol 3, No 1, p 39-43, Fall 1967. 5 p, 9 ref.

Descriptors: *Federal government, *Legislation, *Water pollution, State government, Legal aspects, Social aspects.
Identifiers: Water Pollution Control Act, Water Pollution Control Admin.

The article outlines the history of federal legislation dealing with water pollution. It deals briefly with the acts from the Refuse Act of 1899 to the Water Quality Act of 1965. State legislation is referred to as parallelling the activities of the federal government. The author points out that with the increasing emphasis being placed on water-rights law the common law that has served reasonably well in the past will have to be replaced by new studies, new interpretations and new statutes. (Horner-Fla)
W69-00499

SOUTHEASTERN COMPREHENSIVE PROJECT FOR WATER POLLUTION CONTROL.
Federal Water Pollution Control Admin., Washington, D. C.

Southeastern Comprehensive Project for Water Pollution Control pp 1-12, June 1966. 13 p, 9 photo.

Descriptors: *Federal government, *Water pollution control, Water pollution, *Southeastern U S, River basin development, Legislation, Water quality.

The purpose of this pamphlet is to give an overview of the programs that the federal government has instituted for the Southeastern States in the field of water pollution control. For example, the Federal Water Pollution Control Act of 1956 orders that scientific programs to insure the availability of clean water be developed for all major river basins. The geography and growth of the Southeastern Basin are set forth. Examples of shortcomings in present pollution control measures are given. For example, one third of the municipal sewer systems in the area provide for no treatment whatsoever, and another third provide primary treatment only. Goals are set forth for federal programs, the first being to assist communities in building at least minimum waste treatment facilities and operating them effectively. Present activities of the staff of the Southeastern Comprehensive Project for Water Pollution Control are presented. (Patterson-Fla)
W69-00505

FLORIDA AIR AND WATER POLLUTION ACT.
Fla Stat 403 (1967).

Descriptors: *Florida, *Legislation, *Water pollution, Air pollution, Costs, *Pollution abatement, Permits, Local governments, Recreation, Domestic water, Wastes, Damages, Inspection, Water resources development, Planning, Public health.

This act creates the Florida Air and Water Pollution Control Commission and gives it authority to abate pollution and conserve the waters of the State for domestic, agricultural, industrial, recreational, and other beneficial uses. He sets out enforcement procedures and sets penalties for noncompliance with the Act. It authorizes local governments to establish pollution control programs consistent with the Act. It authorizes variances from the Act upon approval by the Control Commission for the following reasons: (1) There is no practicable means of controlling the pollution involved; (2) Enforcement of the Act would necessitate an unreasonable cost to the individual or corporation concerned; and (3) To relieve or prevent hardship different in kind from (1) or (2) above. The Act sets the tax base of water pollution equipment at its salvage value. The Act allows the state to recover civil damages for pollution of public waters. (Crabtree-Fla)
W69-00509

REORGANIZATION PLAN NO 2 OF 1966 (WATER POLLUTION CONTROL).
U. S. Congress, House Committee on Government Operations, 89th Congress, 2nd Session.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00516

AN ACT RELATING TO THE WATER AND AIR ENVIRONMENTAL IMPROVEMENT COMMISSION.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00518

AN INTERSTATE APPROACH TO WATER POLLUTION ABATEMENT,
Thomas R. Glenn.
Chemical Engineering Progress Symposium Series, Vol 59, No 45, pp 11-14, 1963. 4 p, 1 map.

Descriptors: *Pollution abatement, Water pollution, Water pollution control, Biochemical oxygen demand, Pollutant identification, Public health, Standards, Water pollution treatment, Water quality control, *Domestic wastes, *Industrial wastes, Municipal wastes, Sewage, Sewage effluents, Wastes, Shellfish, Recreation, Water law.

The Interstate Sanitation Commission was created by compact or treaty between New York, New Jersey, and Connecticut for the abatement of existing water pollution and the control of future pollution in the waters of the New York metropolitan area. The Compact recognizes that because of the varied uses of water for bathing, navigation, shellfish culture, fishing, and the disposal of wastes, no single standard of purity is economically practical. Accordingly the waters are divided into two classes: class A - water is expected to be used primarily for recreational purposes; class B - water used for other purposes. The Commission has expended its greatest effort in obtaining the treatment of domestic waste, since this is the source of pathogenic diseases. The jurisdiction of the Commission covers only estuarial and tidal waters and a number of problems not encountered in non-tidal pollution abatement work must be solved. Considerable progress has been made since the Commission was created in 1936, primarily because of the cooperation of many agencies, particularly those charged with pollution control in each of the three member states. (Smith-Fla)
W69-00519

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00528

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00529

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00530

LINDANE ADSORPTION BY LAKE SEDIMENTS,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-00621

CRUSHED LIMESTONE BARRIERS: A BASIC FEASIBILITY STUDY IN THE NEUTRALIZATION OF ACID STREAMS,
Pennsylvania State Univ., University Park.
Robert E. Jarrett, and R. Rupert Kountz.
OWRR Project A-002-Pa. Water Resour Res Publ 2-66, June 1966. 112 p, 13 fig, 8 tab, 5 append.

Descriptors: *Neutralization, *Acid streams, Stream improvement, Hydraulic properties, Calcium carbonate, *Limestones, Hydraulic structures.
Identifiers: Mineral acidity.

In a hypothetical stream a crushed limestone barrier 5 ft deep and 100 ft long seemed capable of successfully neutralizing mineral acidity stemming from sulfuritic minerals when little iron and no silting were present. This basic feasibility study investigated the principle reaction between sulfuric acid and limestone and formulated a barrier design procedure. The relationship between rate of neutralization, mineral acid concentration, fluid velocity, stone size, and head loss was established so further research may develop an inexpensive neutralization method for small streams. The hydraulic properties of crushed limestone were determined; a computational procedure was developed to apply the data for designing barriers. This preliminary engineering data search to satisfy hydraulic and chemical processes simultaneously also determined a shape factor for calculating estimated head loss at different fluid velocities in beds of differently sized particles; and studied the 'overall reaction rate' under various mineral acidity, fluid velocity, and stone size conditions. (Sink-Pa State)
W69-00637

PERSISTENCE OF RESIDUES AND FATES OF HERBICIDES IN RICE FIELDS AND IN RICE FIELD EFFLUENTS,
California Univ., Davis, Botany Dept.
F. M. Ashton.
Final Rep, Water Resources Ctr, 1967. 4 p, 13 ref. OWRR Project A-013-Cal.

Descriptors: *Rice, *Herbicides, Effluents, Weed control, Aquatic weed control, Pesticide residues, Pesticides.
Identifiers: *Rice fields.

Investigations were undertaken to determine residue levels and persistence of herbicides in ricefield waters, determine fates of herbicides in ricefield plants, and develop improved, safe, and effective chemical weed control procedures for rice. Over 65 new herbicides were evaluated for possible use in control of submersed weeds in rice. Of these, formulations of MDMA-endothall, 06K, chloroxuron, and a copper salt of endothall (TD-294) gave outstanding selective weed control in small scale tests, and all but TD-294 performed well in large scale trials. Aerial applications of granular 06K resulted in such good weed control that rice yield increases of 20 and 40% were obtained in 2 separate fields infested with Chara sp. Information contributed by the molinate study has clarified understanding of the action and fate of this new kind of herbicide and should be very useful in further development for rice growing areas.
W69-00669

06. WATER RESOURCES PLANNING

6A. Techniques OF Planning

OPTIMAL AERATION SYSTEMS,
Kansas State University, Manhattan.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-00408

A MATHEMATICAL MODEL FOR SIMULATING THE HYDROLOGIC RESPONSE OF A WATERSHED,
Purdue Univ, Lafayette, Ind.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00568

THE MEKONG DELTA MODEL,
SOGREAH, Grenoble, France.
Henri Lorgere.
Sci J, Vol 4, No 7, pp 70-75, July 1968. 6 p, 5 fig, 2 ref.

Descriptors: Deltas, Mathematical analysis, Flood, Project planning, Flood damages, Computer programming, Reservoir operation, Flood routing, *Flood control, *Simulation, *River regulation, Rivers, Navigation, Land reclamation, Flood plains.
Identifiers: *Mekong Delta, Mekong River Project, Mathematical models, *Tonle Sap Project, Cambodia.

The Mekong River was dammed by computer simulation on one of the world's largest mathematical models. The computer study, financed by Cambodia, Vietnam, and the United Nations Special Fund, was performed by SOGREAH, took 4 yr, and cost 450,000 pounds. Results showed that the dam would bring important economic benefits to the delta area. Annual flooding in the plains of Cambodia and South Vietnam would be reduced by a proposed dam on the Tonle Sap River, a major tributary of the Mekong. Flood damage to rice crops, towns, roads, and bridges would be lessened; more land would become available for agriculture; and the water supply during the dry season would be increased, benefiting irrigation, navigation, and salinity abatement. The method used for constructing the mathematical model and problem solutions are described. (USBR)
W69-00592

OPTIMIZATION OF THE OPERATION OF A MULTIPLE-PURPOSE RESERVOIR BY DYNAMIC PROGRAMMING,
California Univ, Los Angeles.
Warren A. Hall, William S. Butcher, and Austin Esogbue.
Water Resour Res, Vol 4, No 3, pp 471-477, June 1968. 7 p, 3 fig, 4 ref.

Descriptors: *Optimum use, *Reservoir operation, Hydroelectric power, Multiple purpose projects, Reservoirs, Hydrology, Computer programming, Hydrologic data, Runoff forecasting, Mathematical analysis, Streamflow records, Water storage, Outflows, Storage, Programs.
Identifiers: *Optimization, *Dynamic programming, Mathematical models, Inflow, Firm energy, Shasta Dam, Calif.

The dynamic operation policies for planning complex reservoir systems that produce hydroelectric power and provide water can be optimized for the maximum return from firm water and power and dump water and power. The technique provides for complex constraints such as: (1) mandatory flood control reservations that are variable in time; (2) fish, wildlife, and recreational releases; and (3) navigation minimum flows, evaporation losses, and interbasin diversions. The paper presents the operational analysis of a component reservoir-river system and the procedure used to combine optimally a number of such subsystems into a coordinated, mutually reinforcing, multiple-river system. To ensure the essential practicality of the procedure, the analysis is based on the physical and hydrological characteristics of Shasta Dam, Shasta Lake, and Keswick afterbay on the Sacramento River in Calif. (USBR)
W69-00596

THE OPTIMIZATION OF LARGE SCALE WATER RESOURCE SYSTEMS: OPERA-

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TIONAL ASPECTS, PART I: CONCEPTUAL FRAMEWORK,
California Univ., Berkeley, Operations Research Center.
Nathan Buras.
Rep, Univ Calif, Sept 1965. 42 p, 8 fig, 8 ref. OWRR Project A-019-Cal.

Descriptors: *Water resources, Multiple-purpose projects, *Optimum development plans, Municipal water, Industrial water, Irrigation water, Hydroelectric power, Hydrologic data, Inflow, Evaporation, Dynamic programming, Water storage, *Optimization, Linear programming, Water utilization, Mathematical studies.

A water resource system consisting of 4 reservoirs was analyzed with respect to operation in an integrated manner. The reservoirs release water for irrigation, municipal, and industrial uses, and for the generation of hydroelectric power. Requirements are to: (1) determine the maximum amount of firm water and firm power which may be produced by the system, and (2) determine an optimal operating procedure for the satisfaction of the target outputs determined above. Only part (1) is discussed. Optimization of the entire system using dynamic programming was found to be unfeasible due to the large dimensionality of the problem: at least 1 dimension for each reservoir of subsystem. Consequently, the decomposition principle was applied using a combination of dynamic programming (for the optimization of each subsystem) and linear programming (for the optimization of the master program). Hydrological data covering 10 consecutive years and including lowest inflows on record were supplied so that 10 different values of firm water and firm power may be calculated. On that basis of these results, the target outputs for the system as a whole, in terms of firm water and firm power, may be determined.
W69-00658

6B. Evaluation Process

URBAN ENVIRONMENTAL PROBLEMS,
Univ. of Florida, Gainesville.
R. Albertson.
Eng Prog, Univ Fla, Vol XXI, No 6, Bull 128, June 1967. 98 p, 3 fig, 165 ref. OWRR Project A-999-Fla.

Descriptors: River systems, Abatement, *Federal government, *Natural resources, Institutional constraints, Mathematical studies, *Water law, Transportation, Water policy, Cost analysis, Eminent domain, Riparian rights, *Recreation, *Social aspects, *Environment, *Cities.

Reshaping and properly managing the urban environment poses one of the great challenges to contemporary society. Whether this challenge will be met effectively depends, in part, upon the development of channels of communication and the development of action programs among a wide spectrum of disciplines including law, sociology, regional planning, economics, environmental engineering and political science. Unidesciplinary confrontations with the urban challenge are doomed to failure. Under the umbrella of the University of Florida Water Resources Research Center, Professor E. E. Pyatt organized a graduate seminar, 'Urban Environmental Problems,' which was presented during the Spring Trimester, 1966. The keynote speaker was Dr. Allen V. Kneese of Resources for the Future, Inc, with subsequent presentations by University of Florida faculty from a wide array of departments and colleges. The collected papers, dealing with the economic, legal, political and geographic aspects of the urban environment constitute the content of the subject publication.
W69-00401

WATER RESOURCES AND RELATED PROBLEMS IN THE APPALACHIAN REGION OF GEORGIA,
C. E. Kindsvater.
1st Meeting Water Develop Coord Comm, Asheville, Sep 1965. 8 p. OWRR Project A-999-Ga.

Descriptors: *Water resources, *Georgia, Hydrology, Groundwater, Natural resources, Rivers, Springs, Precipitation (Atmospheric), River basin development, Water supply, Water quality, Flood control, Wildlife, Watershed management, Hydroelectric power, Recreation.
Identifiers: Chattachoochee Riv, Ga, Tennessee River, *Appalachian Region, Ga.

This review of water resources and water problems of the Appalachian region of Georgia reveals general areas of need and opportunities for water development and control. The research on which it was based revealed inadequacies in: (1) basic data, (2) technology, (3) coordinated planning and development. These are not unique nor regional problems, but it is hoped that the work begun on this action program for Appalachia will focus attention on the basic need to plan comprehensively for the optimum utilization for all our national resources.
W69-00402

SOCIAL IMPACT OF METEOROLOGICAL DROUGHT IN ILLINOIS,
Illinois Univ, Urbana. Water Resour Center.
Alfred W. Booth, and Don Voeller.
Res Rep 9, Univ Illinois, Mar 1967. 31 p, 12 ref. OWRR Project A-007-Ill.

Descriptors: *Droughts, *Illinois, *Social aspects, Social adjustment, Psychological aspects, Water supply.
Identifiers: Palmer index.

Drought invariably infers a shortage of moisture in one context or another. Attempts have been made to develop a procedure whereby the relative and absolute impact of this phenomenon can be measured. It was proposed to test the validity of meteorological drought, as defined by the recently derived Palmer Index, by comparing the variability of drought in Illinois with the effects of this phenomenon on various sectors of the State's society. Research was based on the hypothesis that the impact of drought on the social realm varies as drought severity varies. Due primarily to lack of long-term, readily available data and developed methodology for isolating effects of natural phenomenon on man, little conclusive objective evidence was obtained; however, drought has a variable impact: (1) from one sector of society to another at a given time, (2) within the same sector of society in given areas at a given time, (3) in given sectors of society through space, and (4) through time on society as a whole, all because of the nature of man's culture enables him to better cope with the vagaries of nature on one hand and results in his becoming more susceptible to them on the other.
W69-00405

A BENEFIT-COST ANALYSIS OF LOCAL WATER SUPPLY,
Wisconsin Univ, Madison.
W. J. Stober, and L. H. Falk.
OWRR Project B-001-La, Land Economics, Vol 53, No 3, pp 328-335, Aug 1967. 8 p, 1 fig, 1 tab, 6 ref.

Descriptors: *Capital costs, *Cost comparisons, Cost-benefit analysis, *Cost-benefit theory, Depreciation, Diseconomies of scale, *Discount rate, Return to scale, Tax rate, Unit costs, Taxes, *Water supply systems, Investment, *Benefit-cost ratios, *Water supplies, Louisiana, Local governments.

Communities facing an industrial-municipal water shortage have 2 broad courses: either private or public financing of water replacement projects. Whether a communit could supply water at a lower cost can be decided by a benefit-cost analysis (differing from analyses for federal projects). The annual benefit from a community project is the present value of the annual cost savings that would result from the nonundertaking of the privately financed alternatives. The average annual cost to the community is the annual net cash outlay for the purchase of water from the community project at a price just sufficient to cover the project costs. The cost of private alternatives is discounted by the corporate costs of capital; the cost of the community project, by the community's costs of capital. A direct consequence of the corporate income tax structure is that the benefit-cost ratio will always be greater than unity if the returns to scale are constant and if both the community and corporate costs are discounted at the same interest rate. A numerical example based on the corporate tax structure in Louisiana demonstrates that a community-financed project, with its lower costs of capital, almost always will be more favorable than a private one.
W69-00410

A COST-BENEFIT ANALYSIS OF MINE DRAINAGE,
Ohio State Univ, Columbus.
Richard A. Tybout.
Reprints of Pap 2d Symp on Coal Mine Drainage Res, Mellon Inst, pp 334-371, May 1968. 37 p, 15 tab, 14 ref.

Descriptors: *Acid mine water, *Mine drainage, *Water pollution treatment, *Cost-benefit analysis, *Regression analysis, Pennsylvania, Water quality control, Taxes, Assessments, Non-structural alternatives, Standards.
Identifiers: OWRR-grant study, Stream quality.

Costs of abatement of acid mine drainage for coal mines in Pennsylvania are calculated and classified by county. Estimates are based on statistical analysis of the data from the Pennsylvania Dept. of Mines and Mineral Industries' Yellowboy Project. The volume of mine drainage is analyzed as a function of historic patterns of coal production, methods of mining, seam thickness, and hydrologic conditions. Costs are estimated for other areas of Appalachia by comparison with Pennsylvania costs. Secondary costs of unemployment caused by closing of mines for failure to treat waste satisfactorily are also estimated. Benefits are not evaluated. The suggestion is made that in many cases treatment cost is greater than benefit and polluters in such cases should pay downstream users for damages as an alternative to treatment. Annual treatment cost estimates for all Pennsylvania active mines are tabulated. The cost of sealing inactive mines is estimated to be $18-36 million. Tables include treatment plant cost estimates, Yellowboy cost regressions and cost functions, number of draining mines by counties, volume of drainage by counties, average thickness of coal seams, correlation matrix for underground and strip mines, drainage volume regressions, and quality of drainage. (Knapp-USGS)
W69-00426

NAVASOTA RIVER WATERSHED, TEXAS (BASIN DEVELOPMENT STUDY REPORT).
Army Corps of Engineers, Washington, D. C.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00442

WATER RESOURCES PROBLEMS AND RESEARCH NEEDS OF NORTH CAROLINA,
North Carolina Univ., Chapel Hill, Water Resour. Res. Inst.
David H. Howells.
Rep 2, Mar 1967. 53 p, 1 map, 2 append. OWRR Proj A-999-NC.

Descriptors: *Water resources, Conservation, Planning, Quality control, Groundwater, Surface waters, *Research and development, *North Carolina.

This summary of North Carolina's water resources problems and research needs serves as the basis for the Water Resources Research Institute's research program. Subject matter is presented within the four broad categories of water resources planning, water conservation, water quantity management, and water quality management. Attention is given to all currently recognized problems and research needs are identified where additional research will contribute to solutions of these problems. The 63 research needs identified in report are summarized in the appendix by research category and relative priority.
W69-00459

ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES,
Resources for the Future.
Irving K. Fox, and Orris C. Herfindahl.
American Economic Review, march, 1964, p 198-206, 20 ref.

Descriptors: *Administrative agencies, Local governments, Benefit-cost analysis, Project evaluation, Federal project policy, Investment, Project planning, Institutional constraints, *Inter-agency cooperation, Optimum development, Plans, Water resources development, *Federal jurisdiction, Pricing, Adoption of practices.

An assessment of the results of existing practices within the federal government upon efficiency is done by examining certain key federal policies which bear on efficiency. One of the most important is that the beneficiaries of a federal water investment project bear only a small portion of the costs. The federal agency involved allies itself with local organizations representing those who will benefit. These interests then dominate the investment decision; what can result is inefficiency resulting from optimistic estimates of benefits and the neglect of cheaper alternatives because most of the pressures are in one direction. Another federal policy that can prove inefficient is the present method of benefit-cost analysis, without application of the marginality principle. Significant errors of concept that are made in evaluation of demand are also pointed out. Suggestions for further exploration of the production function are given as a means to increase efficiency of projects. The desireability of two modifications (1) place greater reliance upon charges and prices in allocation process (2) an independent audit of planning activities are discussed. In conclusion, it is deemed desirable to explore the value of alternative plans even if monetary values are not relevant. (Gargola-Chicago)
W69-00496

MISCONCEPTIONS IN HYDROLOGY AND THEIR CONSEQUENCES,
Colorado State Univ, Fort Collins.
Vujica Yevjevich.
Water Resour Res, Vol 4, No 2, pp 225-232, Apr 1968. 8 p.

Descriptors: *Hydrology, Flood, Forecasting, Ground water, Evaporation control, Climatology, Atmospheric precipitation, Water resources, Flood forecasting, Weather modification, Fluvial morphology, *Errors, Maximum probable flood, Cloud seeding.
Identifiers: Maximum rainfall, Stochastic models, Deterministic model, Risk.

Several misconceptions introduced into hydrology have had adverse consequences on the science and on water resources development. Persistent use of the concept of maximum precipitation and maximum probable precipitation, for which there is no physical proof, has discouraged research into the structure and probability of extreme events, and may have led to an unwarranted sense of security concerning flood control works. Attempts at long-range forecasts of water supply, based entirely on meteorological processes, have misdirected research and raised false expectations. A misconception that hydrologic processes are composed of a limited number of hidden periodicities has retarded the use of modern stochastic analyses of time series. Cloud-seeding to increase numbers of rainfrops rather than their coalescence may have had a negative effect on precipitation in arid regions. Considering ground water as the resource, instead of the aquifer, has stressed the technology of withdrawal at the expense of the study of recharge methods and has led to much unplanned overdraft of ground water. Using descriptive rather than numerical variables has delayed applying modern statistical methods to planning the exploration of the ground-water environment. (USBR)
W69-00580

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
Water Resources Engineers, Walnut Creek, Calif; Washington Univ, Seattle.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00582

THE CALIFORNIA WATER PROJECT: IS PUBLIC DECISION MAKING BECOMING MORE EFFICIENT,
Washington Univ, Seattle.
Gardner Brown, Jr.
Water Resour Res, Vol 4, No 3, pp 463-470, June 1968. 8 p, 27 ref.

Descriptors: *Decision making, Projects, *Water development, Multiple purpose projects, *Economics, Project planning, *Water costs, Benefit-cost ratios, Interest (Finance), Capital costs, Cost comparisons, Water resources, Public utilities, Demineralization, Bibliographies, Policy matters, Efficiencies, Water supplies.
Identifiers: *California State Water Proj, California Water Plan, Bureau of Reclamation, Federal government, Evaluation.

The economic soundness of the Calif State Water plan is discussed and the extent to which the plan shows marked improvement over Federal water projects is shown. The study indicates why economists reach different conclusions. Using an incorrect discount rate, applying procedures that overestimate net benefits, and failing to charge a scarcity price for water are inappropriate arguments against the value of the Calif State Water Project. The existence of alternative public investment opportunities and technological progress in desalination are 2 factors to which the State may have given inadequate attention. Although the State's water pricing policy encourages more efficient resource allocation than that of the Federal government, plausible grounds exist for believing that further improvement is possible. (USBR)
W69-00595

FEASIBILITY OF WATER EXPORT,
Manitoba Univ, Winnipeg, Canada.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-00601

AGRICULTURAL WATER CONSIDERATIONS IN DEVELOPING STATE WATER PLANS,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00607

ORGANIZATIONAL ARRANGEMENTS FOR WATER DEVELOPMENT,
Resources for the Future and Department of Conservation, School of Natural Resources, University of Michigan.
Irving K. Fox, and Lyle E. Craine.
Natural Resources Journal, April 1962, 44 p, 51 ref.

Descriptors: Economies of scale, Government supports, Market value, Administrative decisions, Water resource development, Intangible costs, Attitudes, Project planning, *Administrative agencies, Adoption of practices, River basin development, *Coordination, Decision making, *Interagency cooperation, *Political aspects, Methodology, Water allocation policy, Motivation.
Identifiers: Welfare maximization.

An analytic structure is given, within which designs of institutional arrangements for water resource development can be formulated. This structure consists of four categories: (1) the requirement of the value system, which is welfare maximization, (2) characteristics of the function of producing water services, which are physical interdependencies, economies of scale, indivisibility of services, and benefits difficult to quantify, (3) integration of planning production facilities, operation of facilities, and distribution and marketing of services produced, (4) economic environment and governmental interrelationships. In light of these, existing U.S. organization for water resource development is reviewed and weaknesses of these arrangements discussed. Suggestions for improvement consist of: (1) application of 'market-like' forces, (3) special machinery to coordinate water policies to other related policies, and (4) machinery to assure presentation of alternatives to entire public. (Gargola-Chicago)
W69-00616

THE SIGNIFICANCE OF WATER RESOURCES AS AN ATTRACTION TO INDUSTRY IN THE TOWN CREEK WATERSHED,
Mississippi State Univ., State College.
Don C. Wilcox, William C. Flewellen, and Guy T. Peden.
Water Resour Res Inst Rep, June 1966. 111 p, 7 fig, 36 tab, 17 ref, 3 append. OWRR Project A-002-Miss.

Descriptors: Water resources, Watersheds, *Industrial water, Ground water, *Industrial plants, *Water management, Municipal water, Flood control, Surface water, Population growth, Economics, Mississippi, Bibliographies, Water resources development, *Industries, Economic impact.
Identifiers: Water use.

A study was conducted to determine the significance of water resources to industrial users in the Town Creek Watershed in northeast Mississippi a sub-basin of the Tombigbee River Basin. Ground and surface water conditions in the area, an analysis of current water usage in the watershed, and an evaluation of future uses and needs in the area were studied. Population, manufacturing employment, manufacturing wages, and municipal water customers were factors used to evaluate the relationship between future water needs and water management.
W69-00649

A STUDY OF INSTITUTIONAL FACTORS AFFECTING WATER RESOURCE DEVELOPMENT IN THE LOWER RIO GRANDE VALLEY, TEXAS,
Texas A and M University, College Sta, Texas Agricultural Experiment Station.
Thomas J. Casbeer, and Warren L. Trock.
Technical Report No 1, Department of Agricultural Economics and Soc., Texas A and M University, pp 1-161, Aug 25, 1967. 161 p, 5 tab, 136 ref, 3 append.

Descriptors: *Resource development, *Water rights, *Political aspects, *Legal aspects, History, Drainage, Government.
Identifiers: Economics, *Institutions, Lower Rio Grande Valley.

This report studied the legal, political, cultural, and economic institutions and their impact on the water resource development of the lower Rio Grande Valley, Texas. Also studied were the history of

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development and the water rights of the area. The methodology used consisted of the examination of the institutional arrangements important to the water development of the area. Through studies of past literature, past and present legislation on the national, state, and local levels, and personal interviews, the various factors were characterized. The study also included a climatic and geographical description of the area. It was found that the water supply is limited, the available supply is not being used efficiently, and that there is a severe drainage problem. It is assumed that if people realize that the value and productivity of their property is lowered by these properties, that the institutions will be altered so that corrective action will be taken. (Grossman-Rutgers)
W69-00676

ADJUSTED BENEFIT-COST RATIOS FOR SIX RECENT RECLAMATION PROJECTS,
Resources for the Future, Inc., and University of Washington.
Myrick A. Freeman, III.
Journal of Farm Economics, Vol 48, No 4, Part 1, pp 1002-1012, Nov 1966. 11 pp, 3 tab, 22 ref.

Descriptors: *Federal reclamation law, *Costs, Parity ratios, *Primary benefits, *Secondary benefits, Farm prices, Irrigation.
Identifiers: Economics, *Cost-benefit analysis, *Reclamation.

Six single-purpose projects of the Bureau of Reclamation are reviewed as to the validity of their benefit-cost estimates. The six projects are in Nebraska, Utah, Idaho, Wyoming, and Oregon. Where the benefit-cost estimates were found to be biased, adjustments were made. The estimates made by the Bureau were biased due to their use of a low discount rate, because they counted secondary benefits, and they were over optimistic in their price projections. Also, other sources of bias were not counting the opportunity cost of farm labor, and not counting the opportunity cost of water. The revised benefit-cost estimates are less than one for five of the six projects studied. The author compared estimated project construction costs with realized costs and found the Bureau's estimates to be favorable. (Grossman-Rutgers)
W69-00677

ECONOMIC CONSIDERATIONS IN FORMULATIONS OF NATURAL RESOURCE POLICIES,
Water Resources Council, Washington, D. C.
Harry A. Steele.
Journal of Farm Economics, Vol 48, No 5, pp 1232-1238, Dec. 1966. 7 p, 5 ref.

Descriptors: *Planning, Economic efficiency, *Project life, *Water Resources Planning Act, *Water Resources Council, Benefits, Water quality control.
Identifiers: Economics, Federal Government.

Three purposes of planning are the well-being of the people, economic development, and the preservation of the quality of environment. Plans should be formulated so that they will be comprehensive as to purpose and effects. The following criteria are to be considered in the initial formulation of a plan: tangible benefits should exceed tangible costs; each separable unit or purpose should provide benefits at least equal to its cost; scope of development should provide maximum net benefits; and, there should be no more economical means of accomplishing the same purpose. A second step would be to take account of the intangibles. The length of the project should not exceed 100 years. Current rates should be used. The economic considerations of the Water Resources Council are examined as are the various titles under the Water Resources Planning Act. Four opportunities for the improved application of economics to water resource planning are discussed. (Grossman-Rutgers)
W69-00679

ON THE QUANTITATIVE INVENTORY OF THE RIVERSCAPE,
U S Geological Survey, Washington, D. C., Water Resources Division.
Luna B. Leopold, and Maura O'Brien Marchand.
Water Resources Res, Vol 4, No 4, pp 709-717, Aug 1968. 8 p, 5 tab, 8 ref.

Descriptors: *Aesthetics, *Scenery, *Valleys, California, River basin development, Recreation, Conservation, Watershed management.
Identifiers: *Riverscape inventory, Sampling problems, Scarcity evaluations, Scenic misfits.

In the Berkeley, California area, 24 minor valleys were described numerically in terms of factors comprising social or aesthetic values chosen to represent aspects of riverscape. At each site 28 factors were evaluated. Some were directly measurable, others were estimated, but each observation was assigned to one of five categories for the factor. Each factor for each site was then expressed as a uniqueness ratio, which depended on the number of sites being in the same category. The uniqueness ratio is believed to represent one way in which the scarcity of a given riverscape can be ranked quantitatively without bias based on notions of good or bad, and without assigning monetary value. It is suggested that a classification of scarcity is feasible that can lead to a technique for river survey adaptable in a basic data program in addition to the usual hydraulic and hydrologic factors. Scarcity evaluations might be applied in making choices among alternatives in river basin development. quifer divided by its effective porosity. The distribution coefficient for an ideal tracer is zero; the average velocity of this tracer is equal to the average groundwater velocity. (Knapp-USGS)
W69-00702

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ESTIMATING COST OF GROUND-WATER WITHDRAWAL FOR RIVER BASIN PLANNING,
U S Geological Survey, Water Resources Division.
Este F. Hollyday, and Paul R. Seaber.
Ground Water, Vol 6, No 4, pp 15-23, July-Aug 1968. 9 p, 7 fig, 3 tab, 13 ref.

Descriptors: *Groundwater, *Withdrawal, *Cost comparisons, *Water yield, Unit costs, Specific capacity.
Identifiers: *Cost of groundwater, Potential yield, Susquehanna River basin.

Groundwater costs were estimated in comprehensive planning of water resources development including appraisal of alternative sources of supply in the Susquehanna River BASIN. Log-normal plots on log-probability paper of specific capacities adjusted to 180 days of pumping were used to estimate yields of 65 aquifers. The estimated yields at the 25, 50, and 75% probability levels were obtained using hypothetical well design and selected drawdowns. Unit water costs were calculated from well construction, electrical power, and maintenance costs, all from standard sources. Estimated water costs range from $0.11 per 1.000 gal at 15 gpm to $0.004 per 1,000 gal at 9,000 gpm. A yield of 50 gpm costs $0.060 in shale or interbedded sandstone and shale, and $0.050 in metamorphic rock. A yield of 100 gpm costs $0.043 in shale and interbedded sandstone, and $0.032 in carbonates. A yield of 500 gpm costs $0.020 in sandstone, $0.015 in carbonates, and $0.012 in clacial sand and gravel. A yield of 1,00 gpm costs $0.009 in glacial sand and gravel. Cost differences are caused mainly by differences in pumping levels. (Knapp-USGS)
W69-00436

AUGUSTA POWER CO V US (COST REPAYMENT FOR FLOWAGE EASEMENT).

278 F 2d 1-5 (5th Cir 1960).

Descriptors: *Judicial decisions, *Easements, Eminent domain, Cost repayment, *Compensation, *Land appraisal, Condemnation value.
Identifiers: Flowage easements.

U S (defendant here) filed notice of civil con demnation proceedings with Augusta Power (plaintiff) on lands over which plaintiff held flowage easements. Commissioners found that the criterio for dividing the value of the land in compensatin the owners of the fee and plaintiff's flowage easements was the difference in the value of the lan with and without the flowage easement. Thi method for fixing the compensation was approve by the US District Court for the Southern Distric of Georgia. Both parties appealed. The US con tended that, without a showing by the plaintiff, tha it ever intended to use the easements, no compen sation should be paid for their taking. August Power contended conversely that the compensa tion determined was not enough. This cou reversed, holding that the standard used by th commissioners was erroneous. While a flowag easement doubtless lessens the value of the fe owner's interest, it does not necessarily follow th the amount of such decrease and the value of th flowage easement to its owner is identical. Th maximum compensation payable for such eas ments is so much of the useful value of such lan as the easement owner has a right to destroy depreciate. The actual measure of the compens tion being the practical value of the easement to i owner. (Blunt-Fla)
W69-00469

BOARD OF PUBLIC INSTRUCTION V LITTL RIVER VALLEY DRAINAGE DIST (UNE FORCEABLE RIGHTS AGAINST THE STATE)

119 So 2d 323-327 (3 Dist Ct App Fla 1960).

Descriptors: Florida, *Judicial decisions, Drainag districts, *Taxes, Financing, Legislation, *Deb Land tenure, Public lands, State governmen *Schools (Education).
Identifiers: Constitutional law.

The Board of Public Instruction of Dade Coun sought a declaration of non-liability, to have ce tificates declared null and void and an injunctio against the issuance of tax deeds against holders outstanding tax sale certificates issued for nonpa ment of drainage district special assessments benefits. The District Court of Appeal, reversi held that where the Legislature had not authoriz the Board to pay special assessments for draina district benefits, liens and tax sale certificates bas on nonpayment of the assessments were not e forceable against the property and tax deeds cou not be issued. Article 12 of the Florida Constituti controls the use of funds of the Board of Public I struction and here leaves the defendants with wh the court admits are unenforceable liens and rig without present remedy. (MacMillan-Fla)
W69-00476

SMALLWOOD V CONNER (REASONAB VALUE OF RIGHT TO WELL USE IMPLIED).

162 S E 2d 747-748 (Ct App Ga 1968).

Descriptors: Georgia, Judicial decisions, Le aspects, Usufructuary right, Water rights, *We Value.

Conner conveyed to Smallwood a lot by warra deed, excepting therefrom a 25-foot square i corner on which was located a well. Right to the well and to lay pipe was given. Some years la Conner sued Smallwood, claiming $195 as due o water bill, and obtained a judgment. The court the instant case affirmed. The court stated that

cept as between very near relatives, when one accepts services from another or is given a right to use a facility, a promise is implied to pay the reasonable value thereof. While the warranty deed in dispute clearly conveyed the right to use water from the well, it contained no provision whatsoever that the grantor would supply use of the water free of charge. The court affirmed that $3 per month was a reasonable charge. (Patterson-Fla)
W69-00486

WE NEED MORE MUNICIPAL WASTE TREATMENT WORKS,
David H. Howells.
Civil Eng, Vol 33, No 9, pp 54-55, Sept 1963. 2 p.

Descriptors: Legislation, Water law, *Water pollution control, *Federal government, Pollution abatement, Water pollution treatment, Navigable waters, Municipal wastes, Industrial wastes, Legal aspects, State governments, Local governments, Federal project policy, *Cost sharing, Sewage treatment, Waste treatment.

There are 5,831 cities and towns in the United States, representing over 35 million people, that need new or enlarged plants for the treatment of municipal wastes. The cost of this backlog of needed treatment plants, interceptor and outfall sewers, and other ancillary works, has been estimated at 2.2 billion dollars. The Federal Water Pollution Control Act of 1956, provided the first real impetus to the control of pollution from municipal wastes by authorizing annual appropriations of 50 million dollars for grants of up to 30 percent of the cost of sewage treatment works. In 1961, the Congress amended the Act of 1956 to authorize an increased annual appropriation of 80 million dollars for 1962, 90 million for 1963, and 100 million for 1964 through 1967. It also encouraged communities to construct joint rather than separate projects and increased the 30 percent grant limitation from 250,000 dollars to 600,000 dollars. (R. Smith-Fla)
W69-00493

LEGAL ASPECTS STIMULATE POLLUTION CONTROL PROGRAM,
Murray Stein.
Civil Eng, Col 32, No 7, pp 50-51, July 1962. 2 p.

Descriptors: Legislation, Water law, *Water pollution control, *Federal government, Pollution abatement, Water pollution treatment, Navigable waters, Public health, Water pollution sources, Municipal wastes, Industrial wastes, *Legal aspects, State governments, Local governments, Missouri River.

Remedial waste collection and treatment facilities for municipalities and industries on the stretch of the Missouri River from Sioux City to St. Louis, costing an estimated $350,000,000, are currently in various stages of construction. Much of this activity may have resulted from the four federal enforcement actions taken to abate the pollution of this stretch of the river under the Federal Water Pollution Control Act of July 1956. This article examines in depth the various sections of the Act and concludes that it truly comprises a comprehensive statutory basis for the federal role and responsibility in the prevention and control of water pollution. Since the start of the program in 1956, a total of 2,746 communities began construction of treatment plants with federal funds made available under the act. The total cost of these projects was $1,293 million of which 17% were federal funds. (R. Smith-Fla)
W69-00494

UNDERGROUND-WATER RECLAMATION GRANTS.
43 USCA Secs 351-360 (1964).

Descriptors: *Federal reclamation law, *Permits, Exploration, Drilling, *Water resources development, Patents, *Subsurface waters, Subsurface investigations, Nevada, Federal government, Mineralogy, Coals, Public lands, Reclamation, Regulation, Federal reservations.
Identifiers: *Secretary of the Interior, Land disposal.

Section 351 empowers the Secretary of the Interior to grant exclusive two-year permits to United States citizens to drill for water beneath the surface of designated public lands of the United States in Nevada. Section 352 authorizes the Secretary to designate the lands subject to disposal under this chapter. Section 353 prescribes the procedure and fees for obtaining such a permit. Section 354 empowers the Secretary to cancel the permit under specified conditions. Section 355 entitles the permittee to a patent over one-fourth of the land embraced in the permit if he discovers and develops a specified quantity of water within two years. Section 356 authorizes the Secretary to grant a two-year extension of the time limit. Section 357 provides for the disposition of lands not included in the patents; under Section 358 the proceeds from such dispositions go into a specified reclamation fund. Section 359 reserves to the United States all the coal and other valuable minerals in the lands entered and patented, plus the right to mine and remove them. Section 360 empowers the Secretary to promulgate any regulations necessary to achieve the purposes of the chapter. (Smodish-Fla)
W69-00507

ESTIMATING CONSTRUCTION COSTS,
Day and Zimmermann Consulting Services, Inc.
Thomas W. Hopper.
Consult Eng, Vol 31, No 2, pp 94-98, Aug 1968. 5 p, 1 tab.

Descriptors: *Construction costs, *Estimating, Costs, Overhead costs, Contracting, Bids, Depreciation, Unit costs, Finance, Materials, Foreign construction, Feasibility studies, Consulting engineers, Investigations, Scheduling, Labor.
Identifiers: Agency for Intl Dvlpmt, Construction materials, Profits, Equipment.

The most important uses of construction cost estimates are determining project feasibility and the amount of required financing. In 1967, the Agency for International Development requested an investigation of methods used by consulting engineers and contractors in preparing construction cost estimates for large civil works projects. The investigation revealed that: (1) not enough time is spent on estimating construction costs; (2) engineers concentrate on direct costs and do not thoroughly consider indirect costs that must be included; and (3) the contractors' business costs, including risks, escalation, and legal requirements, are overlooked or not covered sufficiently. Information used in the estimating process should be developed from four sources: site conditions, work division and quantities, construction program, and unit costs. Costs are divided into direct costs (those associated with specific construction operations) and indirect costs (those related to the general construction operation) such as in administrative overhead. Two important estimate items are project mobilization which can be a large part of the project cost, and markup which should be 15 to 20% of the total cost for an average road project in an underdeveloped country. (USBR)
W69-00566

COSTS AND RETURNS FROM CROPS AND LIVESTOCK IN THE UPLAND DESERT VALLEYS OF NEVADA,
Nevada Univ., Reno.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00638

THE MEASUREMENT AND COMPARISON OF COSTS FOR ALTERNATIVE WATER REPLACEMENT PROJECTS,
Louisiana State Univ., Baton Rouge.
L. H. Falk, and W. J. Stober.
Louisiana Water Resour Res Inst Bulletin 2, Oct 1966. 33 p, 1 fig, 7 tab, 13 ref, append. OWRR Project B-001-La.

Descriptors: *Cost comparisons, Costs, *Water supply, Ground water, Wells, Municipal water, *Water costs, Economics, Taxes, Construction costs, Capital costs, Water rates, Water wells, Cost analysis.
Identifiers: Water plans.

Water replacement projects may be undertaken by water users individually or by collective community action. Cost is a primary determinant in the choice among alternative projects. The cost concept relevant for such comparisons is the present value unit cost of water, which may be viewed as an internal price just sufficient to cover all costs. This may be computed by discounting all costs and water outputs by the cost of capital to the sponsoring agency. Calculations indicate that the nonprofit community project can supply water to corporate users at a lower cost than that at which corporate users can supply their own needs. This is attributed to (a) the corporate income tax structure, and (b) the lower cost of capital to the community project. The results of detailed calculations for a hypothetical project are presented in tabular form. In addition, a graph is included that shows the extent to which construction costs for the community project must exceed those for the corporate project to equalize the costs of water from the 2 alternatives.
W69-00641

ECONOMIC CONTROL OF GROUNDWATER RESERVES,
Missouri Univ, Columbia, Dept. of Agricultural Economics.
Oscar R. Burt.
Journal of Farm Economics, Vol 48, No 3, Part 1, pp 632-647, Aug 1966. 16 p, 14 ref.

Descriptors: *Temporal distribution, Costs, *Optimization, *Markov processes, *Mathematical studies, *Functional equations, *Commonality.
Identifiers: Economics, *Groundwater basins.

A framework is developed for the derivation of optimal ground water policies based on sequential decision theory. The policies are based on temporal allocation. The commonality problem is the primary consideration. Two criterion are chosen. The first criterion is the expected present value of net output from the basin. The deviation and solution of the functional equation to maximize this criterion is discussed. The second criterion is the dispersion of net output. Throughout the discussions, the context of net social benefit as a prerequisite for an economic solution is maintained. Markov process analysis is combined with the other mathematical techniques in deriving the optimal solution to the commonality problem. (Grossman-Rutgers)
W69-00678

EFFECTS OF HIGHLY MINERALIZED WATER IN HOUSEHOLD PLUMBING AND APPLIANCES,
Black and Veatch, Construction Engineers, Kansas City, Missouri.
W. L. Patterson, and R. F. Banker.
J Amer Water Works Ass, Vol 60, No 9, pp 1060-1069, Sept 1968. 10 p, 7 fig, 2 tab.

Descriptors: *Corrosion, *Plumbing, *Damages, *Domestic water, *Cost analysis, Water quality, Hardness (Water), Salinity, Dissolved oxygen, Sulfates.
Identifiers: Household plumbing life.

The effects of total dissolved mineral content of domestic water on service lives and annual costs of items of household plumbing and appliances are estimated. The average household plumbing investment is about $1,100. Study of 38 communities shows reductions in service life of 30% in washing machines to 70% in toilet flushing mechanisms from the effect of water of 1,750 ppm. The annual

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cost of such reduction is about $40. The indirect capital costs of reduced life amounts to about $0.40 per 1,000 gal, which exceeds the price of water in many communities. The waters studied had mineral contents not commonly affected by water treatment. The constituents listed are TDS, hardness, sulfate, chloride, and dissolved oxygen. The data obtained in the community surveys are tabulated. (Knapp-USGS)
W69-00704

6D. Water Demand

WATER BASED RECREATION IN NEVADA - TAHOE,
Nevada Univ., Reno, Water Resour. Res. Center.
George A. Myles.
Prog Rep 3, Nov 1966. 22 p, 1 photo, 7 tab. OWRR Proj A-004-Nev.

Descriptors: *Recreation facilities, *Recreation demand, *Nevada, *Expenditures, Beaches, Camping, Camp sites, Lakes, Reservoirs, Social aspects, Tourism, Use rates, Water demand.

National studies estimate that the U S population will double by the year 2,000, but that in this same period the demand for outdoor recreation will triple. With Nevada's rapidly expanding population, estimated to be 500,000 in 1966, and increasing tourist travel by automobile, it is likely that the demand for water based recreation within the state will exceed national averages. The purpose of this study is to provide information concerning: (1) the use of water based recreational areas, (2) desire for satisfaction with facilities and services, (3) the using public's willingness to pay for use of areas and facilities, (4) the expenditures of visitors, and (5) characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities and services. A survey was conducted at major water areas providing information for all of Nevada's major water recreation areas. Results are given for each area because each has its own peculiarities and information is more meaningful on an area basis. A summary of and recommendations for all areas are provided. This work is concerned primarily with Lake Tahoe located in the Sierra Nevada Mountains at 6,000 ft.
W69-00463

WATER BASED RECREATION IN NEVADA - MEAD AND MOHAVE,
Nevada Univ., Reno, Water Resour. Res. Center.
George A. Myles.
Desert Res Inst Proj Rep 3A, Dec 1966. 24 p, 7 tab, 6 photo. OWRR Proj A-004-Nev.

Descriptors: *Recreation facilities, *Recreation demand, *Nevada, *Expenditures, Beaches, Camping, Camp sites, Lakes, Reservoirs, Social aspects, Tourism, Water demand.

National studies estimate that the U.S. population will double by the year 2000, but that in this same period the demand for outdoor recreation will triple. With Nevada's rapidly expanding population, estimated to be 500,000 in 1966, and increasing tourist travel by automobile, it is likely that the demand for water based recreation within the state will exceed national averages. The purpose of this study is to provide information concerning: (1) the use of water based recreational areas, (2) desire for or satisfaction with facilities and services, (3) the using public's willingness to pay for use of areas and facilities, (4) the expenditures of visitors, and (5) characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities and services. A survey was conducted at major water areas providing information for all of Nevada's major water recreation areas. Results are given for each area because each has its own peculiarities and information is more meaningful on an area basis. A summary of and recommendations for all areas are provided. This work is concerned primarily with the Mead-Mohave recreation area in southern Nevada.
W69-00464

WATER BASED RECREATION IN NEVADA WESTERN DESERT AND NORTHERN LAKES,
Nevada Univ., Reno, Water Resour. Res. Center.
George A. Myles.
Desert Res Inst Proj Rep 3B, Mar 1967. 74 p, 4 fig, 10 photo, 2 dwg, 21 tab, 3 chart, 3 append. OWRR Proj A-004-Nev.

Descriptors: *Recreation facilities, *Recreation demand, *Nevada, *Expenditures, Beaches, Camping, Campsites, Lakes, Reservoirs, Social aspects, Tourism, Water demand.

National studies estimate that the U.S. population will double by the year 2,000, but that in this same period the demand for outdoor recreation will triple. With Nevada's rapidly expanding population, estimated to be 500,000 in 1966, and increasing tourist travel by automobile, it is likely that the demand for water based recreation within the state will exceed national averages. The purpose of this study is to provide information concerning: (1) the use of water based recreational areas, (2) desire for or satisfaction with facilities and services, (3) the using public's willingness to pay for use of areas and facilities, (4) the expenditures of visitors, and (5) characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities and services. A survey was conducted at major water areas. This study provides information for all of Nevada's major water recreation areas. A summary and recommendations for all areas are provided. Results are given for each area because each has its own peculiarities and information is more meaningful on an area basis. This study includes Pyramid, Topaz, Walker and Lahontan Reservoir in the west; Rye Patch and Wildhorse Reservoirs, Ruby and Angel Lakes in the north.
W69-00465

SOME OBSERVATIONS ON THE LAW OF WATER ALLOCATION AS A VARIABLE IN INDUSTRIAL SITE LOCATION,
Wisconsin Univ., Madison.
Sheldon J. Plager.
Wis L Rev, Vol 1968, No 3, pp 673-692, 1968. 20 p, 112 ref.

Descriptors: Michigan, Georgia, Water law, Riparian rights, Natural flow doctrine, Reasonable use, *Industrial plants, *Water allocation (Policy), Public benefits, Water utilization.

The article compares water allocation patterns obtaining in a natural flow jurisdiction (Georgia) with those of a reasonable use jurisdiction (Michigan). The patterns are evaluated from the viewpoint of the industrial water user and from that of the public interest in optimum water usage. In a natural flow jurisdiction maximum protection of water supply investment is obtained by locating the plant on riparian land at the furtherest downstream point that a riparian use is possible, thus minimizing the limitation to use created by downstream riparians' rights to natural flow. In reasonable use jurisdictions the opposite is the case, since reasonable use by those upstream (regardless of the time of their arrival) could cut into the lower owner's rights. Courts are less likely to include public interest as a significant factor in the decisional process in a natural flow jurisdiction. Illustrative of the manner in which water laws have often operated in substantial disregard of water facts, defeating the public interest in optimum water use, is the Michigan preference for the upper user in a climate where evaporation losses are small. The converse is the case in Georgia. (MacMillan-Fla)
W69-00467

RAW ENERGY SOURCES FOR ELECTRIC GENERATION,
Ebasco Services Inc, New York, N Y.
F. A. Ritchings.
Inst Elec Electron Eng Spectrum, Vol 5, No 8, pp 34-45, Aug 1968. 12 p, 9 fig, 9 tab.

Descriptors: *Electric power production, Nuclear powerplants, Electric power, Nuclear energy, *Energy, *Hydroelectric power, Costs, Atmospheric pollution, *Consumption, *Forecasting, Resources, Resource development, Water resources, Economics, Transportation.
Identifiers: Electric utilities, Gross national product, Investment, *Fossil fuels, *Nuclear fuels.

The energy picture in the United States through 1985 is outlined. Predictions are that by 1985 nuclear sources will provide more than 40% of the total raw energy for electric power generation in the U S, ranging from 25% in the southwest to more than 70% in New England. Forecasts are based on several factors, including economics, present and future estimates of fuel availability, plant size, transportation, and air pollution. On a national basis, predictions are that consumption of all forms of raw energy for electric generation will increase substantially from now to 1985, with nuclear energy making the greatest gains. (USBR)
W69-00567

ELECTRIC POWER DEVELOPMENT IN THE USSR.

Water Resour J, pp 67-79, Dec 1967. 13 p.

Descriptors: *Electric power production, *Planning, Economics, Thermal power, River basin development, Hydroelectric power, *Foreign countries, Research and development, Natural resources, Costs, Benefit-cost ratios, Transmission (Electrical), Administration, Operation and maintenance, Analysis, Management, Population.
Identifiers: *Rural electrification, Economic evaluation, *Developing countries, Economic growth, Nuclear power, USSR.

Experiences in electric power development in the USSR are related to comparable conditions in developing countries in Asia and the Far East which are anxious to accelerate the electrification program. Research work completed in developed countries can be beneficial to the developing countries of the Economic Commission for Asia and the Far East regions. Broad classifications of techno-economic aspects requiring consideration in the field of electric power production are: (1) planning studies for developing natural energy sources, (2) implementing and administering projects under a comprehensive development plan, and (3) solving technical problems of layout, design, construction, and operation and maintenance of the projects. Observations and conclusions of participants in a seminar and study tour hosted by the USSR are discussed. The seminar and study tour began in Leningrad, proceeded to Volgograd, Yerevan, and Kiev, and ended in Moscow. (USBR)
W69-00569

FEASIBILITY OF WATER EXPORT,
Manitoba Univ, Winnipeg, Canada.
Edward Kuiper.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY4, pp 873-891, July 1968. 19 p, 5 fig, 1 tab, 6 ref, 2 append.

Descriptors: *Water, USA, *Water costs, Water supplies, International compacts, Diversion, Water resources, Project planning, Planning, Water requirements, Policy matters, Economics.
Identifiers: *Water transfer, *Water plans, *Canada, Water shortages, Surplus water, *Export, Treaties, *Import, Inter-basin transfers.

A review is given of various aspects associated with exporting water from one country to another. The first part of the paper deals with the general criteria that must be satisfied before export can be contemplated; the second part describes the application of these criteria to the Canada-United States situation. The continent is divided into 3 regions: mountain west, prairie, and east. Canada's surplus water in the foreseeable future and the approximate cost of providing it to the U S are calculated for each region. The surplus surface water is 100,000,000 ac-ft/yr in the mountain west, 100,000,000 ac-ft/yr in

the prairie region, and 200,000,000 ac-ft/yr in the eastern region. (USBR)
W69-00601

NORTHWEST-SOUTHWEST WATER DIVERSION - PLANS AND ISSUES,
Oregon Univ., Eugene.
Chapin D. Clark.
Willamette Law J, Vol 3, No 4, pp 215-262, 1965. 48 p, 143 ref. OWRR Project A-002-Ore.

Descriptors: Water resources, *Diversion, Water law, Arizona, Interstate compacts, States (Geographical), Underwater, Aqueducts, *Reviews, Bibliographies, Policy matters, *Water transfer, California, Pacific Northwest U.S., Legal aspects.
Identifiers: *Water plans, Water shortages, Pacific Southwest, Pacific SW Water Plan.

Inter-regional diversion of water in the western half of the United States is the most important and controversial issue concerning the management of natural resources presently faced by Congress. Its expense and its precedent require that the existing assumptions about the nature of the water problem and the techniques for its solution be reexamined. The present Congress (89th, 2d Session) may authorize a feasibility study leading to the augmentation of the Colorado River by the transfer of water from the Pacific Northwest. In view of the imminence of the decision, the objective of this article is to present an overview and bibliography of the Northwest-Southwest water diversion issue. The article summarized (1) the political evolution of NW-SW diversion proposals, (2) the physical and institutional factors which press for the acceptance of diversion, and (3) the various diversion schemes suggested by engineers. It concludes with a sketch of the policy issues which are posed by an inter-regional diversion.
W69-00617

SURVEY OF THE NATURE AND MAGNITUDE OF THE WATER RESEARCH NEEDS OF THE TEXTILE INDUSTRY OF GEORGIA,
Georgia Institute of Technology, Atlanta.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00639

WATER: AS A FACTOR TO ATTRACT INDUSTRIES,
Ministry of Agriculture, Ankara, Turkey.
Ismail Sener.
Univ Nebraska, Agr Exp Sta, Rep No 45, March 1967. 18 p, 1 tab, 17 ref. OWRR Project A-004-Nebr.

Descriptors: Water demand, *Water costs, *Locating, *Water supply, Water utilization, Economics, Water quality, Industrial water, Reviews, *Industries, Water shortage.
Identifiers: Allocations, Water facilities, *Industrial development.

Water as a required resource for industry has received nationwide attention in recent years. This study is based largely on a review of literature and interviews with researchers. Water requirements by industry vary--among 38 industries the range is from 80 gallons per gallon of whiskey to 1,920,000 gallons per ton of aluminum. Technology exists that can greatly reduce water requirements--water use per ton of output varies from 1400 gallons to 65,000 gallons for steel and from 1500 to 70,000 gallons for sugar. Site selection by industry is based on many factors considered more important than water because water costs are generally low. A 100% increase in the cost of water to 5 heavy water using industries would increase cost of products less than 1%. The cost of water is generally so low that economic principles are not applied in its use or allocation. The importance of water as a factor in locating industry often has been exaggerated.
W69-00650

PROJECTED RESIDENTIAL WATER REQUIREMENTS FOR THE PLATTE AND GREEN RIVER BASINS IN WYOMING; 1965-2010,
Wyoming Univ., Laramie, Coll. of Commerce and Industry.
James C. Kildebeck, Orman H. Paananen, and John W. Birch.
Wyo Water Resour Res Inst Ser No 5, Univ Wyo, July 1967. 50 p, 2 fig, 40 tab, 2 appen. OWRR Project A-001-Wyo.

Descriptors: *Water requirements, Forecasting, Statistical methods, Water utilization, Estimating equations, Time, Temperature, Costs, *Wyoming, Variable costs, Water consumption, Water demand, *Domestic water, *Municiapl water.

This report provides estimates of long-term residential water requirements for the Platte and Green River Basins of Wyoming. Estimates of residential water use are shown by 5-yr intervals for counties and the entire basin area. Estimates are preliminary and additional research now underway may provide additional evidence to modify initial estimates. Projections are derived from mathematical estimating equations in which temperature, water cost, and time are used as variables for estimation of per capita water consumption. Water consumption data were obtained from a survey of 6 communities in the Platte River Basin (comprising about 2/3 of the basin population), and from Rock Springs and Green River in the Green River Basin. For Platte River Basin, total residential water consumption is expected to increase from 8.3 million gallons/yr in 1965 to 38.3 million gal/yr by 2010. While population in the Platte River Basin is expected to nearly double during this time period, residential water consumption is expected to increase 4 to 5 times. Green River Basin, residential water consumption is expected to increase from 2 million gallons per year in 1965 to 5.4 million gallons per year in 2010.
W69-00668

ECONOMIC IMPACT ON SOUTHWESTERN WYOMING OF RECREATIONISTS VISITING FLAMING GORGE RESERVOIR,
Wyoming Univ., Laramie.
Rodney C. Kite, and Willard D. Schutz.
Wyoming Agr Exp Sta Res J 11, Aug 1967. 24 p, 11 tab, 11 ref, 2 append. OWRR Project A-001-Wyo.

Descriptors: *Recreation, Boating, Demand, Water demand, Wyoming, Input-output analysis, Expenditures, *Economic impact.
Identifiers: *Flaming Gorge Resvr, Utah, Upper Green River, Interviews, Transactions.

The purpose of this study was to analyze the economic impact of expenditures by recreationists visiting Flaming Gorge Reservoir in Southwestern Wyoming in 1962. Through the use of personal interviews, average expenditure for 173 parties was determined. The expenditure was $10.68 per party, with the largest part, $5.26, being spent for gasoline and oil. The Leontief static, open input-output model was used in analyzing economic impact. An overall multiplier of 2.067 was found. This expanded direct benefits from $529,728 to a total benefit of $1,094,798. Sectors receiving the greatest total benefit were, in order of importance: (1) gasoline service stations, (2) other retail, (3) general wholesale, (4) households, and (5) food and beverage establishments. This study is important in showing impact of recreational spending. An appendix presents details on the input-output model including the transactions matrix, the input coefficients, and the multiplier matrix for the study area.
W69-00672

6E. Water Law and Institutions

LECTURES ON LAW IN RELATION TO WATER RESOURCES USE AND DEVELOPMENT,
Univ. of Connecticut, Storrs.
William C. Kennard.
Inst Water Resour, Univ Connecticut Rep 2, Mar 1967. 27 p, 12 ref. OWRR Project A-999-Conn.

Descriptors: *Water law, Riparian rights, Prior appropriation, Water management (Applied), Water pollution control, *Water rights.

Four lectures on water law given in the seminar program of the Institute of Water Resources at the University of Connecticut during the fall semester of the 1966-67 academic year are given in this publication. Dr. F. J. Trelease of the University of Wyoming discussed and contrasted the doctrines of prior appropriation in the western states and riparian rights in use in the eastern states. He stressed the need for a good, comprehensive water use code. Mr. J. J. Curry discussed the role and problems of the Connecticut Water Resources Commission in administering water legislation. Such a group plays two roles; to prevent or discover and eliminate unreasonable use and to develop methods by which riparians can make increasing use of their water rights without detriment to others. Mr. I. L. Newell of the Henry Souther Engineering Co. of Hartford stated that in Connecticut the control of water and wastes is given to two separate agencies, the State Department of Health and the Water Resources Commission. He commented on the recommendations of the Clean Water Task Force. In the final lecture, Mr. W. M. Champion of the University of Mississippi commented on development of policy with regard to water law and the administration of a water rights system.
W69-00400

BIBLIOGRAPHY ON MONTANA'S WATER AND RELATED LANDS RESOURCES,
Montana Univ., Missoula, Water Resour. Res. Center.
Richard G. Sheridan.
Rep 1, Mont. Univ, Dec 1966. 81 p, 947 ref. OWRR Proj B-004-Mont.

Descriptors: *Bibliographies, *Montana, *Water resources, *Land resources, Dams, Agriculture, Irrigation, Reservoirs.

This bibliography has been prepared to make available to researchers, educators, and the general public source materials about Montana's water and related lands resources. In Montana, as in other states, it is difficult to find collected in one place all published materials relating to this subject. In this bibliography an attempt was made to be as complete as possible. Books and articles have been arranged by the limited subject within the water resources field. In addition, a number of sources of general concern to the student in this area are collected near the end of the bibliography. The material relating to governmental administration of water resources is particularly complete. Finally, the bibliography concludes with a list of organizations in the state who have particularly concerned themselves with water resources activities in Montana.
W69-00451

A COMPREHENSIVE WATER AND RELATED LAND RESOURCES PLAN FOR THE STATE OF NEVADA,
Nevada Dept. Conserv. and Natur. Resour., Carson City.
Hugh A. Shamberger.
Inventory Series 1, July 1967. 38 p. OWRR Proj A-999-Nev.

Descriptors: Planning, State governments, Federal government, *Nevada, Census, Resource develop-

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ment, Land use, *Land resources, *Water resources, Natural resources, *Water resources development.

This is the first report in the inventory series prepared for the Nevada Department of Conservation and Natural Resources. The data contained in the Inventory Series will lay the foundation for the preparation of a Water and Land Resources Plan for Nevada. It has long been realized that a directory of federal and state agencies working in the field of natural resources in Nevada would be helpful and to be effective must be kept up-to-date. It is planned to revise this directory at least every 2 yrs.
W69-00462

UNITED STATES V BIGAN (VIOLATION OF RIVERS AND HARBORS ACT-REMEDY).
274 F 2d 729-733 (3d Cir 1960).

Descriptors: Legislation, *Judicial decisions, *Rivers and Harbors Act, *Navigation, *Federal government, Rivers, Navigable rivers.

Defendant operated a strip mining operation at the top of a hill above the Allegheny River. It piled excess earth on an abandoned mining road near the bank of the river. A torrential rain washed this earth, along with brush and trees, into the river creating a bar extending about fifty feet out from the shoreline. The United States brought suit against defendant alleging a violation of the Rivers and Harbors Act, and seeking to invoke the mandatory injunction provision of the Act. The District Court found that such provision could be invoked only to force removal of structures such as docks, constructed in violation of the Act (Sec 10) and that conditions were not such that the court should use its general equity power. This court affirmed, stating that the defendants conduct was negligent and in violation of the Act, but was not the type of violation for which the Act authorizes a mandatory injunction. The court also accepted the findings of the District Court that the situation did not call for the exercise of the general equity power. (R. F. Williams-Fla)
W69-00468

UNITED STATES V GRAND RIVER DAM AUTHORITY (FEDERAL FLOOD CONTROL UNDER COMMERCE CLAUSE).
363 US 299; 80 S Ct 1134-1139 (1960).

Descriptors: *Judicial decisions, Legislation, Navigable water, Navigable rivers, *Federal-state water rights conflicts, Compensation, Condemnation, Federal government, Federal Power Act, *Hydroelectric plants, *Tributaries, Dams, Non-navigable waters.

Respondent was created by the Oklahoma legislature to develop hydroelectric power on the non-navigable Grand River, a tributary of the navigable Arkansas River. It obtained a license under the Federal Power Act and constructed a project on the Grand River. Later, the federal government incorporated the Grand River into its comprehensive plan for the regulation of navigation, flood control, and power production on the Arkansas and its tributaries. It constructed a project on the Grand River, and in connection therewith, condemned a tract of respondent's land, acquired flowage rights over these lands, and paid for relocation of transmission lines. Respondent claimed additional compensation for the taking of its water right and franchise to develop hydroelectric power. The Court of Claims found the U S liable and on certiorari, the US Supreme Court reversed. The power of flood control extends to tributaries of navigable streams. Deprivation of the opportunity to use water for power production in these circumstances is not compensable because of Congress' superior rights under the Commerce Clause. Since no property was taken from respondent, compensation was not required under the Fifth Amendment. (R. F. Williams-Fla)
W69-00470

LOBEAN V TRUSTEES OF THE INTERNAL IMPROVEMENT FUND (TITLE TO SUBMERGED LANDS).
118 So 2d 226-230 (1st DCA Fla 1960).

Descriptors: *Beds, *Ownership of beds, *Taxes, Boundaries (Property), Real property, Florida, Beds under water, Judicial decisions.
Identifiers: Estoppel.

The Trustees of the Internal Improvement Fund issued a Murphy Act deed to the plaintiff in 1946. The deed purported to convey certain submerged lands. In 1956, the trustees advertized a large area of land, including the plaintiff's lot, for sale and the plaintiff brought suit to enjoin such sale. The court held that the Murphy Act deed which the Trustees sold was void and conveyed no title or interest because the lands were submerged and were therefore sovereignty lands not subject to taxation. However, the court held that the Trustees were legally estopped to question the validity of the Murphy Act deed they had issued in 1946. The court did not reach the question but indicated that the Trustees might also be equitably estopped to question the deed. (Horner-Fla)
W69-00471

BOUDREAUX V LANDRY (INTERFERENCE WITH EASEMENT FOR ACCESS TO STREET).

120 So 2d 535-538 (1st Cir Ct App La 1960).

Descriptors: *Judicial decisions, Louisiana, *Easements, *Drains, Ditches, Prescriptive rights, Roads, Access routes.

Plaintiff owned land on the south side of a street. Between his land and the street was a five-foot strip of land. The owner of this strip conveyed an easement to plaintiff for access to the street. Several years later the defendant, police juror for the area, desired to deepen and extend a ditch which was partly on the strip of land. The defendant secured the assent of the owner and commended work over the objections of plaintiff. Plaintiff brought suit for an injunction and damages, claiming that construction of the ditch without his consent constituted a taking of his property without compensation. The trial judge found that plaintiff's restricted right of access to the street was not taken. This was affirmed on appeal. The court held that plaintiff's servitude was only for access directly across the strip. The ditch had not been extended to plaintiff's driveway, so his access had not been interfered with. The court stated that damages would lie if plaintiff's access to the street was interfered with. (R. F. Williams-Fla)
W69-00472

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT V GRIFFITH (NAVIGATION RIGHTS OF RIPARIAN OWNER).
119 So 2d 423-426 (3rd DCA Fla 1960).

Descriptors: *Judicial decisions, Florida, Riparian rights, Canals, *Navigation, Navigable waters, *Public rights, Dams.
Identifiers: Private rights.

Plaintiff, a riparian owner on a canal, brought suit to enjoin the Central and Southern Florida Flood Control District from constructing a salt water control dam on the canal between plaintiff's land and Biscayne Bay. Plaintiff contended that such a dam would deprive it of its right to have unobstructed navigation and access to Biscayne Bay. Plaintiff had no interest in the land which was condemned for construction of the dam, or in the bed of the canal. The chancellor found that the canal was a private navigable waterway owned by appellees and others with similar rights and granted a permanent injunction. On appeal, the Third District Court of Appeals reversed the decision. A riparian owner does not have a vested right to unobstructed navigation, but merely enjoys this right in common with the public. The eminent domain statutes protect only private rights, and plaintiff has only a public right. (R. F. Williams-Fla)
W69-00475

ROY, INC V BOARD OF COMM'RS FOR PONTCHARTRAIN LEVEE DISTRICT (MEASURE OF DAMAGES FOR TAKING OF LAND ABOVE MEAN HIGH WATER MARK).

117 So 2d 60-63 (La 1960).

Descriptors: *Judicial decisions, Louisiana, Lakes, *Lake shores, Tides, *Eminent domain, Condemnation, Levees.
Identifiers: Damages (Legal aspects).

Plaintiff landowner brought an action for damages for the taking of his property by a levee district. The trial court found that the land was above the mean high water mark of the lake upon which it bordered, and awarded damages based upon the fair market value of the land at the time of the taking, plus interest from the date of judicial demand for damages (8 years after the taking). Plaintiff appealed, contending in the alternative that the damages should be the fair market value of the land at the time of the suit, or that interest should have been paid from the time of the taking of the property. The court found that the evidence sustained a finding that the land was above the mean high water mark and therefore subject to private ownership. Where a landowner has knowledge of a taking and stands by without complaint, the damages should be the fair market value of the land at the time of the taking. Pursuant to a statute stating that interest becomes payable from the time a debt comes due, the court held that interest should be paid from the date of the taking. (R. F. Williams-Fla)
W69-00477

JONES V HOGUE (OWNERSHIP OF ALLUVION).

116 So 2d 334-342 (2d Cir Ct App La 1959).

Descriptors: *Judicial decisions, Louisiana, *Accretion (Legal aspects), *Boundaries (Property), Legislation, Riparian rights, Rivers, Banks, Riparian land.

Plaintiffs sought a declaratory judgement apportioning alluvion formed in front of their land and the land of the defendants, adjoining riparian owners. The alluvion was formed over many years and was reflected in five Corps of Engineers' hydrographic surveys. The trial judge interpreted the pertinent statute to require that the alluvion be apportioned at the time of its formation, based on the entire area of the alluvion and entered judgment accordingly. On appeal by plaintiffs, the Second Circuit Court of Appeal of Louisiana reversed the trial court. The court stated that the lower court should merely accept the extent and area of the deposit at the time apportionment is sought. Next, the court held that pursuant to the statute, each riparian owner was to own the same proportion of the new front line or river bank as he had on the old river bank. The point on the new river bank reflecting each owner's proportionate share should simply be connected with the point on the old river bank which marked his property line. (R. F. Williams-Fla)
W69-00478

MENTOR HARBOR YACHTING CLUB V MENTOR LAGOONS, INC (NAVIGABILITY).
170 Ohio St 193; 163 N E 2d 373-378 (1959).

Descriptors: *Judicial decisions, Ohio, *Navigable waters, Recreation, Sand bars, Artificial watercourses, Freshwater marshes, Boating, Natural streams.

An adjacent land owner to an improved channel sought to enjoin owners of land adjacent to lagoons which were connected to Lake Erie by the channel from using the channel. The Supreme Court of Ohio, reversing, found for the defendants that the

watercourse in its present state, including both the channel and the lagoons, were navigable and public waters. The court considered the capacity for boating in natural condition, the capacity for boating after the making of reasonable improvements, and accessibility by public termini. Under Ohio case law navigation for pleasure and recreation is as important to the law as navigation for commercial purposes and a natural temporary obstruction to navigation, in the form of a sand bar, does not destroy the otherwise navigable characters of a watercourse. (MacMillan-Fla)
W69-00481

TOWN OF HEMPSTEAD V LITTLE (RIPARIAN RIGHTS BY ACCRETION).
239 N E 2d 722-725 N Y 1968).

Descriptors: New York, Judicial decisions, *Riparian rights, Boundaries (Property), Boundary disputes, Eminent domain, *Ownership of beds, Riparian land, Water law, *Accretion (Legal aspects).

The issue is whether the Town of Hempstead was a riparian owner entitled to the benefit of the land under water as it accreted and became a part of existing upland owned by the town, or whether Little, the party having title to the land formerly under water, retained title notwithstanding such accretion. The court declared the law on the question to be as follows: Gradual encroachment results in a loss to the riparian owner; but when the land is increased by accretion, i.e., by such a slow and gradual deposit of particles that its progress cannot always be measured even though its results may be discerned from time to time--the new land thus formed belongs to the owner of the upland to which it attaches. Applying this rule to the facts of the instant use, the court concluded that when Little's riparian property was condemned several years before this action was brought, Little retaining only fee to the submerged lands, the town acquired littoral rights including the right to the accretion formed. When the accretions covered Little's submerged lands, they became the property of the town. (Patterson-Fla)
W69-00484

DUMONT V SPEERS (REFUSAL TO AUTHORIZE FISHWAY UPHELD).
245 A 2d 151-155 (Me 1968).

Descriptors: Maine, *Administrative decisions, Legislation, Judicial decisions, *Fish passages, Administrative agencies.
Identifiers: *Public nuisance.

Chapter 331 of the Maine Public Laws of 1929 gives power over the supervision, administration and enforcement of inland game and fish laws to a single commissioner, who has power to require a fishway in a dam when he determines it expedient. Pursuant to Chapter 386 of the Public Laws of 1965, which gives the right to initiate a hearing to determine the expediency of a fishway in a dam to, among others, '200 citizens,' petitioners sought to require the Commissioner of Inland Fisheries and Game to require a fishway in a dam. The court sustained a dismissal of the petition on the ground, that, inter alia, the Commissioner's power to require a fishway is permissive, not mandatory. The legislation does not give petitioners de jure a claim for a fishway in the dam. Since there was legislative authority for the dam as it existed, the rule that obstructions to navigation and the passage of fish in navigable rivers or to the passage of boats, logs, and rafts in 'floatable' streams are public nuisances per se does not apply. (Patterson-Fla)
W69-00485

MEHENE V BALL (COMMON RIGHTS TO BEACH USE).

194 NYS 2d 28-32 (1959).

Descriptors: *Judicial decisions, New York, *Easements, Beaches, Lake Ontario, Recreation.
Identifiers: Tax deed.

This case involved a subdivision which bordered on Lake Ontario. A map which had been filed showing an undivided strip of land along the beach. Plaintiff purchased lots in the subdivision and constructed a permanent dock extending into the lake from the undivided strip (not owned by plaintiff). Defendant purchased a lot adjacent to the undivided strip, and purchased the land between her lot and the water from the county. The county had acquired title to the entire strip in a tax sale. Defendant graded the end of one of the subdivision's streets to improve her access to her lot and remove the part of plaintiff's dock on the land she acquired from the county. Plaintiff brought suit to establish his rights in the strip and street and to compel defendant to return the street and dock to their original condition. The court found that the beach was intended for the enjoyment of all the owners in the subdivision and that such was an easement not cut off by a tax deed. Damages sustained by plaintiff were readily ascertainable so the court refused to issue an injunction. (R. F. Williams-Fla)
W69-00488

LONG ISLAND LIGHTING CO V PEOPLE (OWNERSHIP OF ALLUVION).

196 NYS 2d 756-758 (1960).

Descriptors: *Judicial decisions, New York, State jurisdiction, *Accretion (Legal aspects), Breakwaters, *Riparian land, Beds.

Plaintiff was an owner of waterfront property on Long Island Sound. Its predecessor in title had acquired certain underwater lands by letters patent granted by the State of New York in 1929. As a condition of this grant, the grantee was required to construct certain breakwaters and dredge a channel. This was completed by 1934. Since the construction of the breakwaters, a change has come over the littoral land on either side of them. To the east, 12.25 acres of previously submerged land was exposed, and this controversy centered around this alluvion. Plaintiff submitted exhibits and an affidavit which showed that the increase of land was gradual over the past 25 years. Defendant submitted nothing to contradict plaintiff's evidence, and the court granted plaintiff's motion for summary judgment. Where accretion takes place, such gradual additions to the land belong to the littoral owner and not to the state. (R. F. Williams-Fla)
W69-00489

ATTAINMENT OF EFFICIENCY IN SATISFYING DEMANDS FOR WATER RESOURCES,
Resources for the Future.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00496

COAST GUARD REGULATIONS, POWERS, AND NAVIGABLE WATERS.

Navigation and Navigable Waters, 33 USCA secs 2.01-1 - 2.99-270 (1968).

Descriptors: *Navigable waters, *Coast Guard regulations, *Administrative decisions, Administrative agencies, Legal aspects, Watercourses (Legal), *Jurisdiction.
Identifiers: *Coast Guard, Coast Guard jurisdiction.

Chapter 1. Navigable waters generally, is a part of Title 3 USCA, dealing with navigation and navigable waters. Subpart 2, with which this abstract is concerned, deals with regulations concerning general duties and jurisdiction. The scope of Subpart 2 includes rules and regulations which are statements of policy, interpretive rulings, or descriptions of practices with respect to the general duties and jurisdiction of the U S Coast Guard in the administration and enforcement of navigation and vessel inspection laws. The primary duties of the Coast Guard assigned by law and its law enforcement powers are set forth. The terms 'high seas,' 'navigable waters,' 'waters subject to the jurisdiction of the U S,' and 'state waters' are defined as they are used in statutes. The availability of Coast Guard and other administrative determinations as to navigability and other matters is described. Finally, internal waters of the U S that have been the subject of Coast Guard determinations of navigability are listed. (Patterson-Fla)
W69-00497

NAVIGABLE WATERS GENERALLY.

33 USCA Secs 1-59a.

Descriptors: *Regulation, *Legislation, *Navigable waters, *Non-navigable waters, Canals, Navigation, Interstate compacts.
Identifiers: *Secretary of the Army, Water gauges, Boundary water.

Section 1 establishes the duty of the Secretary of the Army to prescribe regulations for the use, administration and navigation of the navigable waters of the United States. Penalties for the violation of such regulations are set forth. The Secretary is empowered in sections 2 and 3 to regulate parts of the Mississippi River and waters used for military target practice. Section 4 authorizes the Secretary to establish water gauges on the Mississippi River and its tributaries, section 5 abolished tolls on governmental canals, canalized rivers, etc, and sections 6-10 deal with tolls and public use on various waterbodies. Section 11 authorizes the Middle Northwest States to compact as to jurisdiction of offenses committed on boundary waters. Sections 21-59a set forth various bodies of water declared by Congress to be non-navigable. (Patterson-Fla)
W69-00498

NIAGARA POWER PROJECT.

16 USCA Secs 836-836 (a) (1964).

Descriptors: *Federal Power Act, Electric power, Transmission lines, *Hydroelectric project licensing, New York, *Electric power rates, Project purposes, State governments, Power marketing, Scenic highways, Transmission (Electrical).
Identifiers: Niagara Power Project, Niagara River, New York State Power Authority.

The New York State Power Authority was authorized to receive a license from the Federal Power Commission for the construction and operation of a power project on the Niagara River. The license included conditions required by the Federal Power Act, as well as seven specific conditions for this particular project. These specific conditions require the licensee to give preference to public bodies and non-profit corporations within economic transmission distance in disposing of 50% of the project's power. Neighboring states would also be included in this preference. A percentage of the ramaining project power was required to be sold to the licensee of Federal Power Commission Project 16. Notes of decisions are included and updated by annual supplements. (Geraghty-Fla)
W69-00501

WATER CONSERVATION.

16 USCA Secs 590r-590z-11 (1964).

Descriptors: *Water conservation, *Water policy, *Water supply, *Water storage, Water users, Repayment contracts, Irrigation, Dams, Administrative agencies, Irrigation programs, Farms, Cost allocation, Programs, Projects, Federal government, Water utilization.

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Chapter 3c of 16 USCA is divided into two subheadings. The first deals with facilities for water storage and utilization and the second with conservation and utilization projects. The first subheading authorizes the Secretary of Agriculture to formulate and keep current a program of projects for the construction and maintenance of ponds, reservoirs, wells, check dams, pumping installations, and other facilities for water storage or utilization. The Secretary is also authorized to make loans for the purpose of financing the improvement of farm land and to set up an efficient program whereby the government insures loans made for that purpose by other lenders. The second subheading authorizes the Secretary to investigate and construct water conservation and utilization projects in the Great Plains and arid and semiarid areas of the United States and to operate and maintain each project. The statute sets prerequisites which must be met before construction commences, provides for the utilization of services, materials and funds from sources outside the department. The repayment of projects by the water users is provided for in the act. (Horner-Fla)
W69-00502

FACILITIES FOR WATER STORAGE AND UTILIZATION.
16 USCA Secs 590r-590x-4.

Descriptors: *Water conservation, *Water policy, *Water supply, Water utilization, Irrigation, Administrative agencies, Federal government, Farms, Programs, Projects.

Sections 590r through 590x-4 of Title 16 USCA deal with facilities for water storage and utilization. The legislature cites the need for adequate facilities in upholding the national welfare. The Secretary of Agriculture may formulate a program of projects for construction and maintenance of facilities, construct and sell or lease the facilities, co-operate with and aid any agency or person and to acquire lands when necessary. Before extending benefits, the Secretary may require the enactment of State and local laws providing for conservation, the execution of agreements in regard to the maintenance and use of facilities, and contributions to operations conferring benefits. The Secretary may makes loans of federal money for the improvement of farm land or to insure loans made from other sources. The statute outlines a program for the execution, insurance and sale of loans. (Horner-Fla)
W69-00503

WATER CONSERVATION AND UTILIZATION PROJECTS.
16 USCA Secs 590y-590z-11.

Descriptors: *Water conservation, *Water policy, *Water supply, *Water storage, Water users, Repayment contracts, Water utilization, Dams, Irrigation programs, Farms, Federal government, Programs, Projects.

Sections 590y through 590z-11 of Title 16 USCA deal with conservation and utilization projects. For the purpose of stabilizing water supply and thereby rehabilitating farmers on the land and providing opportunities for settlement of farm families, the Secretary of the Interior may investigate and construct water conservation and utilization projects in the Great Plains and arid or semiarid areas of the country and operate and maintain each project. The statute outlines factors to be investigated and provides for the utilization of services, materials and funds of Federal, State, or municipal agencies or individuals in connection with the investigation, construction, or operation and maintenance of a project. No water may be delivered until repayment contracts have been executed by water users organizations or individual landowners. The statute sets certain provisions that must be contained in the contracts. The Secretary of Agriculture is authorized to arrange the settlement of the projects, to advise settlers, to acquire agricultural lands, and to arrange for the improvement of lands within project boundaries. Provisions may be made in connection with any project undertaken, for furnishing municipal water supplies or for developing and furnishing power. (Horner-Fla)
W69-00504

ACQUISITION OF LANDS OR INTERESTS THEREIN FOR USE IN GAGING STREAMS OR UNDERGROUND WATER RESOURCES.
43 USCA Sec 36b.

Descriptors: *Legislation, *Streams, Subsurface waters, Federal government, Gaging stations, Observation wells, Geological surveys, Underground streams, Water resources, Condemnation, State governments, Federal-state water rights conflicts, Irrigation water, Interstate rivers, Water rights, Right-of-way, Easements, Permits, Leases.
Identifiers: *Secretary of the Interior, Territorial Governments, Congressional appropriations, *Acquisition of lands.

Section 36b authorizes the Secretary of the Interior to acquire lands on behalf of the United States for use by the Geological Survey in gaging streams and underground water resources, not in excess of ten acres for any one stream gaging station or observation well site. For the same purpose the Secretary may obtain easements, licenses, rights-of-way, and leases limited to run for such time as may be required for effectively gaging streams and underground water resources. Nothing in the section is to be construed to affect or in any way interfere with the laws of any State or Territory relating to control, appropriation, use, or distribution of water used in irrigation, or any vested right acquired thereunder. The Secretary, in carrying out the provisions of this section, is to proceed in conformity with such laws. Nothing in this section in any way affects any right of any State or of the Federal Government or of any landowner in, to, or from any interstate stream or its waters. (Smodish-Fla)
W69-00508

BEACH AND SHORE PRESERVATION ACT.

Fla Stat Secs 161.011-161.45 (1967).

Descriptors: *Florida, *Legislation, State governments, Local governments, Beach erosion, Sands, Shores, Coasts, *Shore protection, Coastal structures, Jetties, Breakwaters, Beaches, Federal government, Cost sharing, Permits.

The Beach and Shore Preservation Act is divided into two parts. Part one regulates the construction, reconstruction, or other physical activity undertaken specifically for shore protection purposes. This regulation is accomplished by requiring that a permit be obtained from the State Board of Conservation prior to the commencement of such work if it will affect the sovereign lands of Florida below the mean high water line of any tidal water of the state. Part two provides for the division of the state into beach and shore preservation districts and includes the grant of a general power of authority to the administrators to effectively carry out the purpose of this chapter. The Board of county commissioners of any county and its successors in office, as an ex officio duty, are designated as the beach and shore preservation authority for their county. The chapter contains 31 sections and is quite detailed in its enumeration of authority and duties. (R. Smith-Fla)
W69-00511

EFFECT UPON OWNERSHIP AND TAXABILITY OF LANDS - AFFECTED BY ACCRETION, EROSION OR AVULSION.
Rep Att'y Gen Fla, 063-50, May 20, 1963.

Descriptors: *Florida, *Avulsion, Erosion, Riparian rights, Riparian land, Local governments, State governments, *Beach erosion, Bank stability, Coastal engineering, Water law, Ownership of beds, Boundaries (Property), Oceans, Coast, Shores, Beaches.

In reply to certain questions posed, the Attorney General stated that the status of the fee title of an area which formerly was upland, but which now consists of submerged lands, is determined by the manner in which the land became submerged. The Florida courts have adopted the legal principle that where the upland is lost by reason of avulsion and the effect is perceptible, there is no boundary change. If the property was lost by a slow and imperceptible process there would be a boundary change and the title to the submerged area would be vested in the state. Since the land in question has become submerged through both erosion and avulsion, the city, in its efforts to regain beaches through the construction of groins, cannot extinguish the riparian rights of the upland owners affected by such works, and thus it should not undertake such a project until those private upland owners have consented to such a program. (Smith-Fla)
W69-00512

RIPARIAN RIGHTS AND DUTIES,
Vincent Powell-Smith.
The Law J, Vol 115 (NS), No 5171, pp 155-157, March 5, 1965. 3 p, 3 ref.

Descriptors: Water law, *Riparian rights, Artificial watercourses, Reasonable use, *Natural streams, Civil law, *Repulsion (Legal aspects), Percolating water, Surface drainage, Industries, Damages.
Identifiers: *United Kingdom, Common law.

A succinct summary of English water law respecting riparian rights and duties is presented, including case citations and references to Roman and civil law influences. Rights of extraction and use are part and parcel of the natural incidents of ownership. The question of industrial use as an ordinary and reasonable use remains undecided. The landowner is under no common law duty to do anything to correct a natural stream flowing through his land that becomes obstructed by natural causes; however, actions in nuisance, negligence and strict liability may lie in cases where injury stems from nonnatural causes. (MacMillan-Fla)
W69-00513

MCGIBNEY V WAUCOMA YACHT CLUB INC (DOCKS - RIPARIAN LAND).

182 A 2d 622-625 (S Ct Err Conn 1962).

Descriptors: *Connecticut, Navigable waters, Riparian rights, *Docks, Marinas, Littoral, *Riparian land, Rivers, Banks, Damages, Water law, Prescriptive rights.

The defendant for about forty years has owned land on the westerly bank of the river, abutting land which the plaintiff, between 1935 and 1952, leased from Ball and which he purchased from Ball in 1952. Continuously since 1935, the plaintiff has operated on this property a restaurant which has increasingly through the years received patronage from rivercraft. In 1955, the plaintiff built a small dock which he extended by adding floats until, by 1960, he had a 'T' dock on the river in front of his property. The defendant has operated a yacht club since 1930. In 1960, the defendant erected a string of floating docks parallel to the shore and about 112 feet out therefrom. Later defendant ran a dock perpendicularly from the shore out to the string of floating docks. The effect of these actions was to block direct access from the main river channel to the plaintiff's property. The court held that even though plaintiff failed to prove facts from which the trial court could assess the monetary amount of his damages, the trial court was entitled to grant injunctive relief against the tortious interference with plaintiff's littoral rights. (R. Smith-Fla)
W69-00514

UNITED STATES V 461.42 ACRES OF LAND (AVULSION AS IT RELATES TO TITLE).
222 F Supp 55-59 (N D Ohio 1963).

Descriptors: Ohio, Judicial decisions, Lake Erie, Dikes, Riparian waters, Riparian land, *Ownership of beds, United States, Condemnation, Eminent domain, *Avulsion, Beds, Storms, *Beach erosion, Waves (Water), Erosion.

This was a proceeding to determine title to land appropriated by the United States. The State of Ohio and defendant claimed title and the United States sought a judicial clarification of title so that payment for the appropriated land might be made. The land in question had been submerged in Lake Erie since 1929, and Ohio claimed title based on a statute which provided that title to land under Lake Erie would be in the State. Defendant claimed title based on the fact that prior to 1929 the land was above water and became submerged by avulsion after a violent storm. There is an Ohio statute which provides that title shall not be lost by avulsion. Ohio claimed that the storm in 1929 was simply a factor aiding in the erosion of the land, and that land lost by erosion will extinguish title. The land was held to have been lost by avulsion and title remained in the defendant. (Crabtree-Fla)
W69-00515

REORGANIZATION PLAN NO 2 OF 1966 (WATER POLLUTION CONTROL).
U. S. Congress, House Committee on Government Operations, 89th Congress, 2nd Session.

Hearings, Subcommittee of the Committee on Government Operations, House of Representatives, 89th Congress, 2nd Session, March 30 and May 4, 1966.

Descriptors: *Legislation, Administrative decisions, *Political aspects, Water resources development, Administrative agencies, *Water pollution control.
Identifiers: Water Pollution Control Acts.

On March 30, 1966 the Subcommittee of Executive and Legislative Reorganization of the Committee on Governmental Operations House of Representatives met to consider Reorganization Plan No 2 of 1966. The subcommittee heard testimony and received additional material for the record. The Plan would amend the Federal Water Pollution Control Act (33 U S C 466). Basically, the Plan would transfer to the Secretary of the Interior the functions delegated to the Department of Health, Education, and Welfare, under the Federal Water Pollution Control Act except for responsibilities relating to public health. The purpose of the reorganization is to unify water pollution control efforts with the related tasks of managing, developing, and conservation, of water resources which are functions of the Department of the Interior. Objections to the Plan included a possible deemphasis on the public health aspect and unnecessary delay in the implimentation of the Federal Water Pollution Control Act. On May 4, 1966, the subcommittee reconvened to consider H Res 827, a resolution of disapproval of Reorganization Plan No 2 of 1966. The subcommittee heard additional testimony. The subcommittee discussed the effects which the reorganization would have on the employment status of the commissioned officers of the Public Health Service. No action was taken on the resolution. (Molica-Fla)
W69-00516

RECENT DEVELOPMENTS IN RESOURCES AND UTILITIES LAW,
E. F. Taylor.
AWWA J, Vol 56, No 7, pp 863-880, July 1964. 18 p, 44 ref.

Descriptors: *Water law, *Water supply, *Water resources development, *Project planning, Legislation, Judicial decisions, Legal aspects, Water allocation (Policy), Federal-state water rights conflicts, Interstate compacts, Water rights, Federal government, State government, Water rates.

The major developments in water resource laws and programs are considered in the article. One of the most significant developments was the Supreme Court decision authorizing the Secretary of Interior to exercise previously unparallelled powers over the Colorado River's water supply in times of shortage. The author considers the Secretary's plan for managing the river, along with international water resource control plans such as the Great Lakes Water Resources Plan and the Columbia River Basin Compact, and regional plans such as the Delaware River Basin Compact. The problem of federal-state conflicts is examined and Congressional recommendations and judicial decisions in the area are considered. The author then surveys the recent water rights litigation throughout the country. Various states have passed or are considering water resource development programs and plans. The author considers these and state problems in the utilities area. (Horner-Fla)
W69-00517

AN ACT RELATING TO THE WATER AND AIR ENVIRONMENTAL IMPROVEMENT COMMISSION.
Maine Laws Ch 475 (July 5, 1967).

Descriptors: *Main, Legislation, Air pollution, Rivers, Standards, *Water reservoirs, Grants, Sludge, *Sewage treatment, Hydrogen-ion concentration, Sea waters, *Water pollution, Administrative decisions, Administration, Administrative agencies, Water law.

The Water and Air Environmental Improvement Commission's purpose is to recommend methods of controlling pollution of air, rivers, waters and coastal flats caused by municipal sewage, industrial wastes and other materials detrimental to the public health or public use. The Commission recommends that the legislature raise water quality standards when economically feasible. The Commission can accept federal funds for water pollution, water resources and air pollution control. The Commission has four standards for the classification of fresh surface waters and five standards for the classification of tidal or marine waters. The Act describes these classes and the limits and requirements for the use of each. A schedule for compliance to water standards for users of certain waters of the Penobscot River Basin and Waldo County is provided. Methods for enforcing these standards and procedures for appealing Commission decisions are established. The Commission is also required to make studies relating to the causes and prevention of air pollution. (Childs-Fla)
W69-00518

AN INTERSTATE APPROACH TO WATER POLLUTION ABATEMENT,
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00519

APPLICATION OF 253.122 F S TO SUBMERGED LANDS OWNED BY ONE OTHER THAN THE ABUTTING UPLAND OWNER,
Richard Ervin.
Rep Att'y Gen Fla 059-191, Sept 25, 1959.

Descriptors: *Florida, Administrative agencies, Adjudication procedure, Administrative decisions, *Beds, Ownership of beds, State governments, Contracts, Jurisdiction, *Legislation, *Bulkhead lines, Permits, Coastal structures, Landfills.

This opinion responded to questions from a trustee of the internal improvement fund involving one's right to fill submerged lands: (1) purchased from one abutting upland owner, or (2) purchased with consent of the abutting upland owner, and (3) such owner's duty to comply with the Bulkhead Law. The trustee also asked if a full record of proceedings setting a bulkhead line was required. The Attorney General replied that even though prior to 1957 an owner of submerged land had a statutory right to bulkhead and fill such lands, and this was a contract right, such contract right could be impaired in persuance of the state's police power. He concluded that the passage of the 1957 Bulkhead Law was an exercise of the police power, that it did impair contract rights, and therefore owners of submerged lands in both cases posed in the questions must comply with the Bulkhead Law, regardless of when they or the persons under whom they claimed acquired the lands. He also stated that a full record of proceedings setting bulkhead lines was necessary. (R. Williams-Fla)
W69-00520

WATER RIGHTS LITIGATION,
Edward F. Taylor.
AWWAJ, Vol 58, No 5, pp 535-554, May 1966. 20 p, 54 ref.

Descriptors: Droughts, Water conservation, Interstate, Water supply, *Delaware River Basin Commission, *Interstate compacts, State governments, Municipal water, *Water permits, Riparian rights, Prior appropriation, Water pollution control, *Long-term planning, Local governments.
Identifiers: Water impasse, Model Water Use Act.

The drought that seized the Northeast in 1965, and which regularly seizes the West, pointed out the need for water laws of national and regional scope but more importantly, for farsighted local plans. The states of New York, New Jersey and Delaware launched long-range attacks on the problem of water supply and conservation through the Delaware Basin Commission. Local government's primary responsibility is to protect and develop water supplies. Determining who has priority is the key in developing comprehensive rules to govern the use of water. The Model Water Use Act is a major aid in water-law revision as it incorporates the most workable provisions of many state and local systems. Western water law is the article's main topic. (Geraghty-Fla)
W69-00521

BASS V FARRELL (TITLE TO ACCRETED LAND).
Arkansas, Little Rock.

370 S W 2d 54-59 (Ark 1963).

Descriptors: Erosion, *Channel erosion, Bank erosion, *Acretion (Legal aspects), Boundaries (Property), Lumber, meanders, Currents (Water), Shores, Riparian land, Maps, Judicial decisions, *Arkansas, Areal.

Involved in this dispute between riparian owners are concepts of erosion and accretion. Defendant was enjoined from cutting timber on land formed by accretion. The appellate court upheld the injunction because the defendant, as the real plaintiff in this suit, did not sustain the burden of recovering on the strength of his own title. The appellate court did not consider defendant's numerous exhibits persuasive of his claim. The apportionment portrayed in the exhibits was untenable. It is common knowledge that a bank is eroded by the pressure of the current against the shoreline. Aerial photographs showed discernable lines of erosion on the upstream site only, indicating that the channel did in fact travel downstream from west to east. This negated defendant's assumption that the accretions in issue were formed as the river moved from the north to the south. (Harriett-Fla)
W69-00522

VILLAGE OF OLD FIELD V SCHUYLER (LICENSE TO DREDGE ON STATE SUBMERGED LAND).
13 N Y 2d, 191 N E 2d 460-464 (1963).

Descriptors: *Dredging, Channel improvement, *Navigation, Navigable waters, Jurisdiction, Federal jurisdiction, State jurisdiction, *Permits, Administrative agencies, Legislation, *New York.

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The appellant realty company owned land fronting on Long Island Sound. This included two jetties extending into the Sound, which had been constructed by the predecessor in title persuant to an easement from the State. The appellant sought to dredge between the jetties. This necessitated obtaining a license from the Land Office. The statute requiring the license required Certification by the Army Corp of Engineers that dredging was necessary to improve navigation. Respondent argued an appeal that the State had no authority to issue the license, since certification had not been obtained. The Court of Appeals disagreed. It reasoned that the Corp of Engineers, when issuing the permit to dredge, tacitly understood the purpose to be improvement of navigation. Failure of the permit to specify navigation did not preclude the State from issuing its license. (Harriett-Fla)
W69-00523

BURKART V CITY OF FORT LAUDERDALE (RIPARIAN RIGHTS).
156 So 2d 752-766 (Fla DCA 1963).

Descriptors: *Florida, Judicial decisions, *Riparian rights, Navigable waters, *Accretion (Legal aspects), Land tenure, *Easements, Right-of-way, Public rights, Highways, Access routes.

Owners of lots in a subdivision brought suit against the city of Ft Lauderdale, Florida, to resolve the question of ownership of riparian rights. The lots were bounded by a street that ran along a navigable stream. The court held that where a street was laid out so that it was bounded on one side by navigable waters, dedication of the street to the public operated to relinquish to the public and merge into the public right dedicator's individual right of access to the open navigable waters in front of the dedicator's uplands. Owners of upland were not vested with riparian rights to the exclusion of the riparian rights accruing to the easement for the street even though they owned the underlying fee in the street. The dissent urged that riparian rights should not be treated, as here, as an indivisible package of privileges attached exclusively to the easement, and that plaintiffs should be adjudged owners of the land formed by accretion with such riparian rights and privileges as do not burden the easement according to the purpose of its dedication. (MacMillan-Fla)
W69-00524

STATE V KULUVAR (CHANGE IN CROSS-SECTION OF PUBLIC WATERS).
123 NW 2d 699-707 (Minn 1963).

Descriptors: Permits, Federal jurisdiction, International boundaries, State jurisdiction, Reservation doctrine, Federal-state water rights conflicts, *Legislation, Judicial decisions, *Minnesota.
Identifiers: *Criminal law.

Defendant was convicted for violating a Minnesota criminal statute prohibiting interference with public waters subject to state control without authorization. The Supreme Court of Minnesota rejected two arguments for reversal, but accepted a third. The court rejected first the assertion that there was a conflict between federal and state authority. There was no showing that compliance with the State statute interfered with federal exercise of power over an international boundary. The court also rejected plaintiff's argument that the statute was too uncertain to be constitutional. The court did declare, however, that in order to justify the conviction, it must be established that the use of the waters, past, present, or reasonably likely in the future, has been detrimentally affected by the unlicensed change. Evidence of such detrimental effect was lacking. (Harriett-Fla)
W69-00525

FLOOD CONTROL REGULATIONS.

33 CFR Part 208, Jan 1, 1968.

Descriptors: United States, Cost allocation, Maintenance costs, Project planning, State governments, *Flood control, Flood protection, *Flood routing, Levees, Sand boils, *Dams, Reservoirs, Drainage, Channels, Bank protection, Riprap, Seepage, Right-of-way, *Regulation, Engineering.

Structures constructed by the U S for local flood protection shall be continuously operated and maintained by states or political subdivisions thereof, who furnish assurances that they will do so in accordance with regulations prescribed by the Secretary of the Army and without cost to the U S. They shall appoint permanent committees, headed by 'Superintendants' who will be responsible for the operation, maintenance and inspection of such facilities. Before improvements or repairs of project works are undertaken, a superintendant must contact the District Engineer of the Dept of the Army. The superintendant must also submit semi-annual reports to the District Engineer. Maintenance and operation procedures are outlined to insure the serviceability of levees, drainage structures, pumping plants, channels, floodways and other flood control facilities. The Upper Potomac River Commission is responsible for the operation of the Savage River Dam and Reservoir. Operating instructions are detailed in the chapter, including a Storage Reservation Diagram. Responsibility for the operation of the Alpine Dam and Reservoir, the Bear Creek Dam and Reservoir and the Weiss Dam and Reservoir are also described in detail. Much of the chapter deals with the operation of dams and reservoirs in western states, notably California. The publication is kept up to date by annual supplements. (Geraghty-Fla)
W69-00526

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
Fla Admin Code, Ch 285, Secs 28-5.01 to 28-5.21.

Descriptors: Permits, *Florida, *Legislation, Administrative agencies, State jurisdiction, Water law, State governments, *Water pollution treatment, Water pollution control, Water quality control, Pollution abatement, *Drainage wells, Water pollution, Water quality, Industrial wastes, Municipal wastes, Standards.

The rules included in this chapter deal with the pollution of waters within the territorial limits of the State of Florida. The rules enumerate the standards of water quality desired and provide for the testing procedures to be used to insure compliance with the standards. The waters of the state are divided into five classifications and detailed criteria are provided for ascertaining the degree of purity required of each class. The rules state it is the intent of the State of Florida to review Class V stream classifications periodically and as water quality improves, hearings will be held and reclassification shall be established. The rules also provide for the regulation of drainage wells. (R. Smith-Fla)
W69-00528

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
Fla Admin Code, Ch 285, Secs 28-5.01 to 28-5.04.

Descriptors: Permits, *Florida, *Legislation, Administrative agencies, State jurisdiction, Water law, State governments, *Water pollution treatment, Water pollution control, Water quality control, Pollution abatement, Water pollution, Water quality, Industrial wastes, Municipal wastes, Standards.

The following minimum conditions are applicable to all Florida waters, at all places and at all times. Within the territorial limits of this state all such waters shall be free from: (1) settleable substances, (2) floating substances, (3) deleterious substances, and (4) toxic substances. Tests or analytical procedures to determine compliance or noncompliance with water quality criteria provided by this chapter shall be in accordance with methods given in the latest edition of Standard Methods for the Examination of Water and Wastewater. All industrial wastes or other wastes shall be effectively treated by the latest modern technological advances as approved by the regulatory agency. All discharges from municipal and privately owned domestic waste plants will comply with the Water Quality Standards of the State of Florida with 90% treatment or better as expeditiously as possible, but not later than Jan 1, 1973. (R. Smith-Fla)
W69-00529

FLORIDA AIR AND WATER POLLUTION CONTROL COMMISSION - POLLUTION OF WATERS.
Fla Admin Code, Ch 285, Secs 28-5.05 to 28-5.21.

Descriptors: Permits, *Florida, *Legislation, Administrative agencies, State jurisdiction, Water law, State governments, *Water pollution treatment, Water pollution control, Water quality control, Pollution abatement, *Drainage wells, Water pollution, Water quality, Industrial wastes, Municipal wastes, Standards.

The rules also set 21 quality control standards to provide the criteria for determining the degree of pollution. The waters of Fla are classified according to their usage as follows: (1) Class I - public water supplies; (2) Class II - shellfish harvesting; (3) Class III - recreation and the propagation and management of fish and wildlife; (4) Class IV - agricultural and industrial water supply; and (5) Class V - navigation, utility and industrial use. The above classifications are discussed in detail as to the criteria of each and the classifications are reviewed periodically. The rules also provide for the regulation of drainage wells. Before any municipal or private corporation or persons shall use an existing drainage well or drill a new well for the discharge of surface water or sewage, it must apply to the Commission for a written permit authorizing the drilling and use of said well. (R. Smith-Fla)
W69-00530

REGULATION OF THE DEVELOPMENT OF WATER POWER AND RESOURCES.
16 USCA Secs 791-797 (1968).

Descriptors: *United States, *Legislation, *Federal Power Act, Public lands, Reservation, City, Navigable waters, Projects, *Water resources, Permits, Hydroelectric project licensing, Reservoirs.
Identifiers: Federal Power Commission, Powersites.

This act establishes the Federal Power Commission. The composition of commission and the restrictions placed on commissioners are detailed. The Commission employs a chief engineer and other officers. Public lands, reservations, corporations, person, state, municipality, navigable waters, municipal purposes, government dam, project, project works, commission, state commission and security are defined. The Commission's general powers are: (1) investigations and data collection on water resources, the water-power industry, power sites and power from government dams: (2) statements of license investment in projects; (3) cooperation with the executive department; (4) publication of information and reporting to Congress; (5) license issuance for construction of dams, reservoirs, etc.; (6) issuing preliminary permits; (7) investigating occupancies developing power. Preliminary permits are not transferable and are subject to cancellation. Licenses are valid for fifty years. The controls over permits are explained. There are limitations on license transfer. (Childs-Fla)
W69-00531

REGULATION OF THE DEVELOPMENT OF WATER POWER AND RESOURCES.

16 USCA Secs 798-806 (1968).

Descriptors: *United States, *Federal Power Act, Legislation, Navigation, Right-of-way, Sluices, Locks, Dams, *Navigable waters, Monoply, Channel, Projects, Permits.
Identifiers: Amortization reserves, Public use.

Conditions imposed on FPC license include: (1) the project adopted must be the best for developing a waterway for public use; (2) alteration of the approved project is allowed only in emergencies; (3) the project must be maintained; (4) amortization reserves must be maintained; (5) reimbursement is to be paid by a benefited licensee; (6) other consistent conditions may be required; (7) monopolistic combinations are prohibited; (8) certain of these conditions may be waived. Project work affecting navigable waters may have additional conditions included in their license: (1) if the project is a dam then the construction of locks, booms, sluices, etc, may be required; (2) if these are not to be constructed by the licensee, then the right of way is to be given to the United States; (3) the licensee is required to furnish the power for these structures. If navigation requires additional construction but the cost is unreasonable, then the commission will request Congress to participate. The licensee must commence construction within two years from licensing and proceed with due faith and diligence. The Attorney General may act to secure a license revocation and the sale of unfinished works. (Childs-Fla)
W69-00532

REGULATION OF THE DEVELOPMENT OF WATER POWER AND RESOURCES.

16 USCA Secs 807-823 (1968).

Descriptors: *United States, Legislation, *Federal Power Act, *Permits, Compensation, Coast Guard Regulations, State regulation, *Rates, Channel, Eminent domain, Navigable waters, Public lands, Reservations.
Identifiers: National safety, Secretary of the Army, Navigational facilities, Public service licensees.

When an FPC license expires, the Government may acquire the works upon payment of compensation equal to the net investment. Licenses may be renewed. The Government may use projects when necessary for the national safety and upon payment of compensation. Provision is made for disposing of charges arising from licenses. The Coast Guard may direct the maintenance of lights and signals. The Secretary of the Army regulates navigational facilities. Penalties are prescribed for non-compliance. All public-service licensees must abide by state regulation, unreasonable, discriminatory and unjust rates are prohibited for interstate power. When property is necessary for the public interest to develop a waterway, it may be acquired through eminent domain. Rights vesting prior to June 10, 1920 are not affected. It is unlawful to maintain works affecting navigable waters, public lands, reservations or use surplus water or water power from a Government dam except under certain conditions. A license is required for works affecting interstate or foreign commerce. The Attorney General may act to prevent license violations. This chapter does not affect state law relating to water used for irrigation or other purposes. This act is annotated and supplemented. (Childs-Fla)
W69-00533

BODICK V HARCLIFF MINING CO (OBSTRUCTION TO STREAMFLOW BY MINING WASTES).

208 Pa Super 471, 222 A 2d 615 (1966).

Descriptors: *Pennsylvania, Remedies, Adjudication procedure, *Flood damage, *River flow, *Obstruction to flow, Ice jams.

A trespass action was brought for damages to plaintiff's house, located 300 feet from the edge of the Allegheny River. Plaintiff alleged that debris from defendant's strip mine, consisting of the remains of a spoil wall which had slid into the river channel approximately 1/2 mile downstream, interfered with the normal flow of the river causing an ice jam, unusually high flood waters, and the resultant damage to his home. After verdict for plaintiff, defendant moved for judgment N O V and for a new trial, both of which were denied. This Court affirmed, holding that whether the debris interfered with the normal flow of the river was a jury issue. There was sufficient evidence of proximate cause to submit the matter to the jury. Defendant's negligence may be the proximate cause of an injury where it is a substantial factor in bringing about the injury or when it concurs with an act of nature and defendant cannot show that the injury would have occurred independently of his negligence. (Kahle-Fla)
W69-00534

KNIGHT V CIARLONE (INTERFERENCE WITH LITTORAL RIGHTS).
200 NYS 2d 805-807 (1959).

Descriptors: *Judicial decisions, *New York, *Riparian land, Riparian rights, Docks, *Easements.
Identifiers: Injunctions.

Defendants had an easement over plaintiffs property for the purpose of gaining access to a lake upon which plaintiff was a littoral owner. Defendants constructed a dock extending into the lake from plaintiff's property. Plaintiff brought suit to compel defendants to remove the dock. The Chancellor stated that a littoral owner on a lake has not only title to the low-water mark of the lake, but as an appurtenance or easement thereto, he has a right of access to and from the lake waters and to build such docks as will not interfere with navigation. The Chancellor held that defendant's easement did not include the right to construct a dock and that such construction interfered with plaintiffs' littoral rights. The injunction was granted. (R. Williams-Fla)
W69-00535

STEBBINS V ORANGEBURG MFG CO (STREAM POLLUTION).

10 App Div 2d 859; 199 NYS 2d 124-125 (1960).

Descriptors: *New York, Judicial decisions, Streams, *Damages, Pollution abatement, *Water pollution, Chemical precipitation, Waste treatment, Riparian rights.

Plaintiff property owner sought an injunction and damages for pollution of a creek adjacent to his property by defendant's discharge of industrial wastes. The New York Supreme Court, Appellate Division, held that evidence sustained finding that industrial waste discharged by defendant caused the creek to be below the standard of purity required by water pollution control board and caused emission of chemical odor constituting a nuisance and entitling owner to damages. Denial of the injunction was proper because of the installment by the defendant of a chemical treatment plant. (MacMillan-Fla)
W69-00536

RANDLE V CITY OF ROME (MUNICIPAL LIABILITY FOR STORM DRAINS).
195 NYS 2d 373-376 (1960).

Descriptors: *Judicial decisions, *New York, *Cities, Drains, Surface runoff, Surface drainage, *Storm drains, Obstruction to flow, Water injury, Floods.

Plaintiff property owner brought an action against the city, alleging negligence in its operation of storm drains, resulting in the backing up of water in the street and on plaintiff's property. The city moved to dismiss the complaint. The court held that notice of a defective condition did not have to be given to the city under such a provision in its charter, where the city creates a dangerous condition through its active negligence. The judge summarized New York on municipal liability for water damage and concluded that where a city has undertaken to provide a drainage system, negligence in the operation and repair of such system will render the municipality liable for damages. The court held that the plaintiff's complaint stated a cause of action and denied the city's motion to dismiss. (R. Williams-Fla)
W69-00537

FAIRCHILD V KRAEMER (PUBLIC RIGHTS IN TIDAL MARSHES).
193 NYS 2d 512-514 (1959).

Descriptors: *Judicial decisions, *New York, *Navigation, *Tidal marshes, Easements, Ownership of beds, Tidal waters, Harbors.

Plaintiff held title to part of a sound, which had consisted, prior to 1893, of sand ridges, salt marshes and tidal creeks. Around 1893 the area was dredged so as to become a deep, commonly used harbor for pleasure craft. In 1959, plaintiff hired a watchman and challenged those who wished to enter the harbor. He brought an action of trespass against defendant, claiming title to the bottom of the harbor because it was man-made. The court held that the area was always subject to the public's navigation rights since tidal creeks opened into the sound. Generally all salt waters where the tide ebbs and flows are navigable in law, giving rise to a right of navigation vested in all the people. This is true even though the tidal creeks may not be actually navigable at low tide. Judgment was rendered for defendant. (R. Williams-Fla)
W69-00538

SMITH V PEOPLE (LANDS APPROPRIATED FOR STATE RESERVOIR).
193 NYS 2d 127-130 (App Div 1959).

Descriptors: *Judicial decisions, *New York, State governments, *Reservoirs, Islands, Eminent domain, Compensation, Condemnation, *Maps.
Identifiers: Adverse possession.

Plaintiff brought an action to quiet title to part of an island in a state reservoir. Plaintiff contended that the strip of land which connected the island to the mainland was covered by water only in the spring. Thus the strip was a peninsula and not part of the land appropriated by the state for the reservoir. The map filed when the award was made to plaintiff's predecessor in title showed the land as included in the appropriation. A New York Statute provided that such award maps are presumptive evidence of state ownership. The Supreme Court, Appellate Division, affirming a judgment for the State by the trial court, held that plaintiff had not overcome the presumption of state ownership. The court additionally held that since the state constitution forbade the disposal of any canal lands unless no longer in use and because these lands were held in trust for the public, the state could not have alienated them. Plaintiff's claim to title through adverse possession was barred. Alienability is a prerequisite for operation of adverse possession. (R. Williams-Fla)
W69-00539

MARANDOLA V BEAUREGARD (FLOODING OF LOWER LAND).

158 A 2d 876-877 (R I 1960).

Descriptors: *Judicial decisions, *Rhode Island, *Floods, Streams, Obstruction to flow, Water injury, *Pipes.
Identifiers: Evidence.

Complainants owned land below that of respondents. A natural watercourse had flowed from time

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immemorial from a pond on respondents' land across complainants' land. Complainants filled in their land and enclosed the watercourse in a pipe, which had a bend in it and which did not follow the natural course of the book. This pipe became blocked and flooding of complainants' land and a town highway resulted. Complainants contended that the respondents caused this flooding by deepening the drainage ditch from the pond and filling in such pond. Complainants brought suit to enjoin respondents from further excess discharge and to recover for damages already suffered. The trial court found that the complainants had been the cause of the flooding, and dismissed the bill. The Rhode Island Supreme Court affirmed. (Williams-Fla)
W69-00540

ALLEN V MORRIS BUILDING CO (SURFACE RUNOFF DAMAGE).

360 Mich 214; 103 NW 2d 491-493 (1960).

Descriptors: *Michigan, Judicial decisions, Surface waters, Surface runoff, *Repulsion (Legal aspects), *Riddance (Legal aspects), Drainage water, Damages.

Homeowners in Michigan sued a building company and its majority stockholder and president for damages caused by water flowing onto their land as a result of grading and construction. The supreme court held that the fact that defendants willfully graded and built downspouts causing waters in excess of natural flowage to be channeled onto plaintiffs' property causing damage was enough to warrant recovery without negligence or violation of city ordinance. Plaintiffs were not required to raise the grade of their lot to mitigate damages. Where an individual, who is majority stockholder, president and in control of defendant corporation's activities personally supervised such grading and construction, he participates in the tort and is personally liable with the corporate defendant. (MacMillan-Fla)
W69-00541

REKEDALL V COUNTY OF REDWOOD (DITCHES).
102 NW 2d 682-689 (Minn 1960).

Descriptors: *Minnesota, *Ditches, Legislation, State governments, Drainage, *Assessments, Benefits, Compensation.

The petitioners sought to use Judicial Ditch No 33 as an outlet for the proposed Judicial Ditch No 32. The district court granted authority and fixed the benefit to Judicial Ditch No 32 at $12,500. The property owners who had been assessed to pay for No 33 sought appeal from the order claiming that the $12,500 only paid for actual changes to No 33 to enable No 32 to use it and it did not include any of the cost of the original construction of number 33. The Supreme Court held that the district court and not a jury had the power under MSA 106.531, to fix the terms and conditions for the use of a ditch as an outlet. The court held that the landowners were not an aggrieved party entitled to appeal the court decision under MSA 106.631. That section only provided for appeal when benefits were assessed upon landowners for the construction of a ditch. That was not the case here since the landowners were not being assessed. (Horner-Fla)
W69-00542

ESSOCK V TOWN OF COLD SPRING (DRAINAGE DITCH).
10 Wis 2d 98; 102 N W 2d 110-114 (1960).

Descriptors: *Drainage, *Ditches, *Assessments, Legislation, Local governments, Legal aspects, Wisconsin.

The plaintiff landowner brought action to set aside a special assessment made upon his land for cleaning out a drainage ditch contiguous to the land. The court held that the town board complied with the statute outliving procedures on complaint of obstruction and the statute outliving the manner of apportionment of assessments. The board's action was not arbitrary or unreasonable and its determination is conclusive. (Horner-Fla)
W69-00543

FLYNN V BEISEL (RIPARIAN RIGHTS).
102 N W 2d NW 2d 284-293 (Minn 1960).

Descriptors: *Riparian rights, *Easements, *Riparian land, Navigable waters, Ownership of beds, Boundaries (Property), Real property, Water law, Legal aspects.

The plaintiff sought to enjoin the defendants from erecting a dock at the termination of a public easement abutting on a navigable lake. The plaintiff admitted that the public has easement rights of ingress to and egress from the lake but alleges that the rights are restricted to travel only and not to use of navigable waters beyond the water's edge. The court held that the roadway to the lake had been established by common law dedication and therefore the public had the same riparian rights as any riparian owner. Riparian rights are an incident of ownership of the shore and not ownership of the bed of a lake. Riparian owners have a right to make use of a lake over its entire surface, in common with all other abutting owners, provided such use is reasonable and does not interfere with the rights of abutting owners. (Horner-Fla)
W69-00544

OAKLAND CLUB V CITY OF SOUTH EUCLID (SURFACE RUNOFF).
165 NE 2d 699-703 (Ohio Ct App 1960).

Descriptors: Municipalities, Drainage systems, Water law, Repulsion (Legal aspects), *Controlled drainage, Drainage, Drainage water, Large watersheds, Judicial decisions, Riparian waters, *Storm drains, Storm runoff, Surface runoff, *Surface drainage, *Ohio, Sewers, Reasonable use, Running waters, Surface water, Diffused surface water.
Identifiers: Capacity of the stream rule, Civil law rule.

Plaintiff maintained a golf course for the use of its members. A natural watercourse flowed through that land serving to drain surface water accumulating in the general area. Taking advantage of this natural watershed area and several small tributaries that ran into the watercourse, defendant municipality constructed a stormwater sewage system to collect and dispurse surface water from municipal land adjacent to the golf course. Plaintiff alleged that defendant's drainage system burdened the watercourse beyond its natural capacity causing the golf course to flood in times of heavy rainfall. Plaintiff contended that, under the capacity-of-the stream rule, the defendant may in the reasonable use of its land drain water from the land into its natural outlet and thus increase the volume and accelerate the flow without incurring liability; but it may not do this beyond the capacity of the watercourse in its natural drainage. Noting that such was not the rule in this jurisdiction, the court held that defendant could collect into sewers the surface water which comes from a watershed area within its borders and discharge it into such watercourse without liability to the plaintiff even though in so doing incidental damage occurred to the plaintiff. (Kuder-Fla)
W69-00545

EBERLE V GREENE (OBSTRUCTION OF SURFACE WATER FLOW).

18 Ill 2d 322; 163 NE 2d 822-826 (1960).

Descriptors: Control, Dams, Water control, *Drainage, Surface drainage, Surface waters, *Illinois, Judicial decision, Water law, *Surface runoff, Water rights, Obstruction to flow.
Identifiers: *Civil law rule.

The plaintiffs, servient landowners, brought an action to enjoin neighboring dominant landowners from obstructing the flow of surface water over their property. The court held that when surface water naturally flowed from the property of the defendants due to the contour of the land, the plaintiffs had a right to have the flow of surface water continue unimpeded. A dam built by the defendants to prevent flow was ordered torn down, with the court holding further that an order to return the boundary to its natural state was sufficiently clear. However, the plaintiffs had the right to build a dam on their property if it did not impede the flow of surface water onto the land of others or change the natural course of drainage. (Headley-Fla)
W69-00546

SHEEHAN V RICHMOND COUNTY (EMINENT DOMAIN AND HIGHWAY DRAINAGE).

100 Ga App 496, 111 SE 2d 924-927 (1959).

Descriptors: Drainage, Drainage systems, *Eminent domain, Tile drainage, Storm runoff, Ponding, Flooding, *Surface runoff, Drainage effects, Surface drainage, *Easements, Georgia, Third party effects.

Plaintiff sued the county to recover damages to his property caused by flooding and ponding water on his property as a result of the highway being so constructed as to expel large quantities of water through water traps and gutters at given points. The highway drainage system for the drainage of rain water from the road had recently been constructed incident to other highway improvements. The continuous channeling of surface water across property to its damage amounts to the taking of an easement over the lands. This falls under the state constitutional provision requiring adequate compensation for property taken or damaged for a public purpose. The fact that plaintiff's property did not abut the highway, as property owned by others was situated between, does not defeat plaintiff's right to recovery. (McDermott-Fla)
W69-00547

MISSISSIPPI STATE HIGHWAY COMM'N V PETERSON (FAIR VALUE IN EMINENT DOMAIN PROCEEDINGS).
117 So 2d 452-454 (Miss 1960).

Descriptors: *Judicial decisions, *Mississippi, *Eminent domain, *Condemnation value, Compensation, Condemnation, Water wells.
Identifiers: Evidence.

This case involved an eminent domain proceeding in which the State Highway Commission condemned a strip of appellees' land. Such taking would include two shade trees and cause damage to a well, which was the only good well in the area. The jury rendered a verdict for $4,200, while the testimony of experts was all to the effect that the damage was less than $1000. However, these witnesses did not consider the shade trees or the well in their estimations. On appeal to the Mississippi Supreme Court, the court held that the verdict was grossly excessive and that such damages were not shown by proper evidence. The court stated that damages could not be recovered by appellees' for losses suffered by neighbors who had used the well. The case was reversed and remanded for a new trial. (R. Williams-Fla)
W69-00548

BERTRAM V STATE ROAD DEPARTMENT (CONSTRUCTION OF BRIDGE OVER WATERWAY).

118 So 2d 674-675 (3d DCA Fla 1960).

Descriptors: Florida, *Remedies, Channels, Water law, *Adjudication procedure, Public rights, Riparian rights, Judicial decisions, Water rights, Inland waterways, *Relative rights, Bridge construction.
Identifiers: Marine interests, Intercoastal waterways.

Plaintiffs, a large number of marine interests, sought a declaratory decree, injunction and other relief to prevent construction of a fifty-five foot vertical clearance fixed span bridge across the intercoastal waterway in Biscayne Bay, Dade County, Florida. This court affirmed the circuit court's dismissal of the complaint for failure to state a cause of action. Plaintiffs right to use the waterway was no greater than that of the public at large since they were not riparian owners. Since special damages different from that inflicted on the public at large were not alleged the plaintiffs stated no cause of action. (McDermott-Fla)
W69-00549

FURTEK V WEST DEER TOWNSHIP (SURFACE DRAINAGE).

19 Pa D and C 2d 169-181 (Com Pl 1959).

Descriptors: Agricultural watersheds, *Drainage systems, Drainage, Ditches, Drainage water, Runoff, Storm drain, Storm runoff, Surface drainage, Surface runoff, *Drainage effects, *Repulsion (Legal aspects), Drains, Soil erosion, Judicial decision, *Pennsylvania, Cities.
Identifiers: Trespass.

The plaintiff brought an action in trespass against the defendant township to recover damages to plaintiff's land allegedly resulting from the closing of a surface drain in a highway. The action of the defendant diverted diffuse surface waters from other areas of natural drainage and caused them to be discharged upon the plaintiff's land, thus increasing the area of the watershed drainage over his premises. The court held that although the plaintiff was required to fight the common enemy as best he could, he was not required to bear more than his share of the burden. The township had no right to cause drainage from other watershed areas to be discharged upon the land of the plaintiff so as to increase the amount of drainage over his property. (Kuder-Fla)
W69-00550

JONES V TOMAN (COMMON-ENEMY DOCTRINE OF SURFACE WATERS).

60 Lack Jur 217-222 (Pa Com Pl 1959).

Descriptors: Water law, *Pennsylvania, Drainage effects, *Surface runoff, Surface waters, Damages, Soil erosion, Alluvion, Relative rights, Judicial decisions, Surface drainage, Runoff, *Repulsion (Legal aspects).
Identifiers: *Common-law rule.

Defendants, neighboring landowners to plaintiffs, filled in a portion of their land. The raised level of their land resulted in surface water and alluvial soil flowing onto the land of the plaintiffs. Defendants acted to improve the drainage conditions of their property. Plaintiffs now suffer a similar problem and are suing to compel its correction and to enjoin this condition from continuing. The common-law rule, or 'common-enemy' doctrine, prevails in Pennsylvania. Thus one may use his property as he pleases and fend off surface waters without taking into account the consequences to other landowners. Since water is descendible by nature, the owner of a dominant or superior heritage has an easement in the servient or inferior tenement for the discharge of all waters which by nature rise in or flow or fall upon the superior. This is true even if alluvial soil is taken along and deposited on another's land. Liability exists only where the owner of the higher land is guilty of negligence which causes unnecessary damage to his neighboring landowner, or where by an artificial channel he collects and discharges surface waters in a body or precipitates them in greatly increased quantities upon his neighbor. Plaintiffs' complaint was dismissed and judgment entered for the defendants. (McDermott-Fla)
W69-00551

MICHAELSON V SILVER BEACH IMPROVEMENT ASS'N INC (OWNERSHIP OF ACCRETION).

173 N E 2d 273-280 (Mass 1961).

Descriptors: *Accretion (Legal aspects), *Massachusetts, Real property, *Riparian rights, *Riparian land, Ownership of beds, Low water mark, Mud flats, Boundaries (Property), Easements, Judicial decisions.
Identifiers: Artificial accretion.

The plaintiff riparian land owner brought suit to enjoin the defendant bathing society from using a beach created by the Commonwealth in front of the plaintiff's land. Under Massachusetts law riparian ownership extends to the low water mark and where accretions are made to land along the seashore, the line of ownership follows the changing water line. The accretion did not have to be due to natural causes for the rule to apply. In some cases, however, where the Commonwealth creates lands as an incident of its power to improve navigation the title belongs to the Commonwealth. In this case there was no showing that the lands were formed as a result of a project to improve navigation and the usual rules of accretion apply even though the land was entirely created by the Commonwealth. (Horner-Fla)
W69-00552

YEZIORO V NORTH FAYETTE COUNTY MUNICIPAL AUTHORITY (RIGHT TO CONTINUED SERVICE FROM PUBLIC UTILITY).

193 Pa Super 271; 164 A 2d 129-144 (1960).

Descriptors: *Utilities, Water works, Public utilities, Water distribution (Applied), Profit, Water conveyance, Judicial decision, *Public rights, Water conveyance, Pennsylvania, Water rates, Pipelines.

This was an appeal from a decree enjoining the municipal authority from discontinuing water service to several customers. Public consumers had attached individual service lines to a private line owned by the local school board. When the school board discontinued service to its building, the authority threatened to stop all service to that private line unless the consumers agreed to take responsibility for the line. The Appellate Court, in affirming the trial court, said that abandonment of service cannot be justified solely on the basis of the private nature of the line. The court also held that public use, inconvenience and hardship to the public, and availability of a substitute service must be weighed against the authority's loss of profits. The court further stated that it was the duty of the authority to provide safe, reasonable service to the public for reasonable and uniform rates. (Sisserson-Fla)
W69-00553

VERMONT WOOLEN CORP V WACKERMAN (WATER POLLUTION ABATEMENT).
167 A 2d 533-541 (Vt 1960).

Descriptors: Vermont, *Water pollution control, Classification, Judicial decisions, Public health, *Legislation, Change orders, Administration, Installation costs, Costs, Riparian rights, Industrial wastes, Industrial plants.
Identifiers: *Police power.

Plaintiff, an industrial corporation, appealed an order of the state conservation board which classified waters adjoining plaintiff's plant as beyond Class D, those that contain sewage or industrial waste to the point of nuisance. Plaintiff attacked the constitutionality of the legislation that gave the conservation board the power to issue such classification orders. The court, in upholding the legislation's constitutionality, stated that the promotion of the public welfare and the providing of the maximum of beneficial use and enjoyment of the waters of the state to its people is a proper exercise of police power. In answer to the plaintiff's complaint of the unreasonable cost of installing equipment to prevent further pollution, the court said that strongly favored policy considerations will outweigh burdensome cost even if financial hardship is placed on a particular individual. The court also said that the board must furnish reasonable notice of its classifications. (Sisserson-Fla)
W69-00554

TOWNSHIP OF HATFIELD V LANSDALE MUNICIPAL AUTHORITY (RIGHT TO PERCOLATING WATERS).

403 Pa 113, 168 A 2d 333-334 (1961).

Descriptors: *Percolating water, *Water wells, Groundwater, Water supply, Water table, *Water rights, Water law, Legal aspects, Water utilization, Equitable apportionment, Reasonable use.

Plaintiff sought to enjoin the defendant municipality from operating its well because a trial run caused dehydration of some surrounding wells and a dimunition in water supply in others. The issue was whether there is a right of absolute appropriation of percolating waters. This court affirmed the trial court's holding that there is no absolute right to appropriate percolating waters where the water is diverted for sale to others away from the land. The trial court was within the broad powers of a court of equity in ordering the municipality enjoined unless it joined to its system without cost all interested injured parties within a radius of 1600 feet from the well. (Horner-Fla)
W69-00555

WILLIAMSTOWN V RUBY (RIGHTS UNDER EASEMENTS).
336 S W 2d 544 (Ct App Ky 1960) 336 SW 2d 544-547 (Ky 1960).

Descriptors: *Kentucky, Judicial decision, *Easements, Competing uses, Access routes, Dams, Public rights, *Property disputes, Usufructuary right.
Identifiers: *Retained rights.

Appellee conveyed an easement to the Department of Fish and Wildlife Resources which was subsequently assigned to appellant city. The easement granted the right to build and maintain a dam on or adjoining appellee's land and create a pool of water thereon. It also granted the right of ingress and egress over a fifty foot strip of appellee's property. The city sought an injunction to stop appellee from trespassing on the fifty foot strip and from operating and renting motorboats for use on the lake. Appellant maintained that it had the right to exercise absolute dominion over it's lake and over the strip of land. The court held that the city took only those rights that were granted in the easement. The rest were retained by the grantee. The easement was granted for the use and enjoyment of the facilities of the dam and the lake by fisherman. The appellee was, therefore, entitled to use the land for any purpose which did not interfere with the proper enjoyment of the easement. (Sisserson-Fla)
W69-00556

CONRAN V GIRVIN (TITLE TO ACCRETION).

341 S W 2d 75-104 (Mo 1960).

Descriptors: *Accretion (Legal aspects), *Riparian land, *Riparian rights, Real property, *Avulsion,

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Bank erosion, Boundaries (Property), Low water mark, Ownership of beds, Channels, Islands, Legislation, Water law, Judicial decisions.
Identifiers: Evidence.

Plaintiff claimed title to an island which had formed in the Mississippi River adjacent to the defendant's riparian land. A state statute gave counties title to islands formed inside the county and the plaintiff held title under a patent from the county. In Missouri, riparian owners hold title to the low water mark. Evidence showed that the land did not form in the river from that part of the bed to which the state had retained title and hence the title never rested in the county. Therefore the plaintiff's patent did not convey title. The evidence showed that the nucleus of the island was originally accretion on the plaintiff's land which was above the low water mark of the river. Then the accretion grew and a channel was cut between it and the mainland. When the river cuts a new channel, not by eroding away the intermediate lands but by jumping over them leaving a part of the land of a riparian owner intact and identifiable then the title to that land so cut off remains in the riparian owner. (Horner-Fla)
W69-00557

ADAIR V FRISBY (DAMAGES FROM SALT WATER DISCHARGE).
State of Arkansas, Little Rock.

345 SW 2d 468-469 (Ark 1961).

Descriptors: Judicial decisions, *Arkansas, Discharge (Water), *Saline water, Encroachment, Property values, *Water pollution effects, Damages, Overflow, Streams.

Appellees sought damages for the discharge of salt water by appellants into a creek which flowed through appellee's property. The only issue on appeal was whether the judgment was excessive. Appellee testifird that prior to the damage his entire tract of 177 acres was worth $17,000; after the damage was done, the land was worth $10,000. He also introduced evidence that the salt water killed timber, causing it to fall and clog a creek which flowed across his land, thereby overflowing 54.5 acres of the property, reducing such acreage in value from $100 per acre down to $25 or $30 per acre. This damage alone would have amounted to around $4,000, and there was evidence that it would have cost more than $4,000 to clear the creek of fallen timber. Appellants' evidence tended to show that the damages did not exceed $900. On these facts, the court held that the award of $2,375 damages was not excessive, and affirmed the judgment. (Smodish-Fla)
W69-00558

CITY OF DANVILLE V SMALLWOOD (COMPENSATION FOR RETROACTIVE CONDEMNATION).
347 SW 2d 516-520 (Ky 1961).

Descriptors: Judicial decisions, *Kentucky, Condemnation, Cities, *Compensation, Diversion, Storm runoff, Damages, Obstruction to flow, Washouts, Foundation failure, Storm drains.
Identifiers: Restoration.

The City of Danville constructed a storm sewer and in so doing blocked off a former channel which carried off rain water. Water was then forced into a concrete pipe which ended in front of plaintiffs' residence. Dirt piled at the end of the pipe formed an obstruction to the flow of the water. A very heavy rainfall occurred after the city had been notified of the condition, but before any damage had been done. The dirt obstruction caused an unnatural diversion of the water onto the yard of plaintiffs' home and so undermined the foundation of the house that large portions of it collapsed. The yard was also severely washed and damaged. The court held that the facts constituted 'a condemnation suit in reverse,' or 'a retroactive condemnation of land,' and that the City of Danville had to pay compensation to plaintiffs for loss of the use of the home and restoration costs. (Smodish-Fla)
W69-00559

BOARD OF COM'RS V ST LANDRY PARISH SCHOOL BD (COMPENSATION BY STATE FOR TAKING LAND).

130 So 2d 692-696 (Ct App La 1961).

Descriptors: *Louisiana, Judicial decisions, *Condemnation, *Compensation, Levees, Navigable waters, Flood control, Mississippi River, Public rights, Land tenure, State governments.
Identifiers: Constitutional law.

The Louisiana Court of Appeal affirmed a decision in favor of a parish school board in a declaratory judgment action to determine whether a levee board was required to pay a parish school board $182 for lands actually used for a right-of-way for levee and levee drainage purposes. A servitude was found to exist in favor of the public on lands in Louisiana adjacent to navigable rivers and streams for the purpose of constructing and repairing levees to confine the waters of such watercourses. The State may appropriate riparian lands burdened with this servitude without prior judicial proceedings and without compensation for the actual value. The court held that the landowner was entitled to compensation for actual value where, as here, the land was not taken for purposes of confining overflow but rather in aid of the overall diversion of the excess water of the entire Mississippi Valley. This included artificial diversion of waters into floodways or other routes outside the major channel of the Mississippi. (MacMillan-Fla)
W69-00560

NORTH DADE WATER CO V ADKEN LAND CO (ENJOINING LAKE POLLUTION).

130 So 2d 894-899 (3d DCA Fla 1961).

Descriptors: *Florida, Judicial decisions, *Sewage effluents, Pollution abatement, Lakes, *Water pollution, Water law.

An owner of land surrounding two landlocked lakes sought to enjoin defendants from discharging water and sewage effluent through a conduit into the lakes. He claimed that such action constituted a private nuisance (odors and pollution of lakes) and a continuing trespass resulting in irreparable damage for which there was no adequate remedy at law. The Florida appellate court held that the owner was entitled to an injunction where no right to discharge into the lakes had been reserved. The additional expense in discharging into a creek rather than the lakes did not excuse or justify defendant's actions. (MacMillan-Fla)
W69-00561

ROLLAN V POSEY (BOUNDARY LINE DISPUTE).
126 So 2d 464-469 (Ala 1961).

Descriptors: *Boundaries (Property), Real property, *Non-navigable waters, *Ownership of beds, Streams, Tidal waters, Water law, Legal aspects, Riparian rights, Riparian land, *Alabama.

Complaintants and respondents dispute the ownership of land described in both their deeds. The respondent claimed the 40 acres contained in the SE quarter of the NW quarter of Section 12. A non-navigable stream flows through the northern part of the plot. The complaintants' land is to the north of the respondents' and is described as running to the stream. The disputed land lies between the northern boundary of the SE quarter of the NW half and the stream running south of that boundary. The court held that the owner of land bounded by a non-navigable stream owns to thread of the stream. This was the true boundary because the plaintiff had been in possession originally and his title was not disturbed by the respondents adverse possession. (Horner-Fla)
W69-00562

AMERICAN MORTGAGE CORP V LORD (TITLE TO ACCRETIONS).
132 So 2d 40-42 (2 DCA Fla 1961).

Descriptors: *Accretion (Legal aspects), Real property, Boundaries (Property), Riparian lands, Riparian rights, Water law, Legal aspects, Judicial decisions.

The question was whether accreted lands were passed by a deed conveying certain government lots. The lands were described in two ways in the deed. One part said certain lots were conveyed and the other said all of the named lands lying in a certain township. Unless excepted the title to accretions passes with the title to the land to which the accretions are appurtenant. The court held there was no conflict between the descriptions and in neither were the accretions excepted. The accretions passed with the land. (Horner-Fla)
W69-00563

WATER PERMITS IN MARYLAND.
Maryland Laws, Ch 415 (1967).

Descriptors: *Maryland, *Legislation, Administrative agencies, *Water allocation (Policy), Water consumption, *Permits, Water permits, Water law, Water utilization.

This act added a new section to Article 96 A of the Annotated Code of Maryland, title 'Water Resources,' subtitle 'Appropriation of Water; Reservoirs and Dams.' The new section authorized the Department of Water Resources to review existing required water usage permits to ascertain that appropriation and use was in accord with the permit. The permits could be corrected if the appropriated amounts of water were not or did not have to be used. (Sisserson-Fla)
W69-00564

RULES OF CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT.
Fla Admin Code, Chapter 152, 1968. 29 p.

Descriptors: *Administrative agencies, Budgeting, *Florida, Inter-agency cooperation, Local governments, Planning, Project planning, Regulation, Water districts, *Flood control, Public benefits, Tax rate, Drainage districts, Eminent domain, Permits, Right-of-way, Recreation facilities, Relocation, Political constraints.
Identifiers: Cooperative emergency construction, *Flood control district, Secondary works, Spoil policy, Flood control account.

The District's authority, power, and organization are outlined. It must plan and provide for District works and facilities and cooperate with the federal government and other governmental agencies whenever possible. It has the power of eminent domain. Attention must be paid to recreational uses of District works. The policy for the issuance of permits for the use of District land and works is outlined. General construction requirements are provided for in a separate District publication. Rules are established for the cooperative emergency construction program whereby non-District projects may acquire District assistance. Secondary works may be undertaken in emergency situations. Procedure for acquiring rights-of-way is outlined. The disposal of surplus lands and policy with regard to the relocation of privately owned facilities are provided for. Spoil policy is outlined. Financial procedure, including a flood control account in the general revenue fund and the power to levy a uniform ad valorem tax of up to 1 mill on all property in the District, is established. Officers and employees of the District are prohibited from engaging in political activity. (McDermott-Fla)
W69-00565

LEGAL ASPECTS OF WEATHER MODIFICATION-SNOWPACK AUGMENTATION IN WYOMING,
Wyoming Univ, Laramie.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-00612

ORGANIZATIONAL ARRANGEMENTS FOR WATER DEVELOPMENT,
Resources for the Future and Department of Conservation, School of Natural Resources, University of Michigan.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00616

LAW OF WATER RESOURCES OF THE STATE OF MISSISSIPPI,
Mississippi State Univ., State College, Coll. of Law.
Parham Williams.
Rep, Water Resour Res Inst, Miss State Univ, June 1966. 23 p, 30 ref. OWRR Project A-006-Miss.

Descriptors: *Water laws, *Mississippi, *Legal aspects, Riparian rights, Water utilization, Water resources, Watercourses (Legal).

The object of this report was to determine the problems created by the conflicting claims to water use and control in Mississippi, to explore how these conflicting interests have been protected by legislative act, judicial decision and administrative regulation, and to formulate recommendations, where warranted, for legislation and regulations necessary to achieve the desirable objectives.
W69-00661

A STUDY OF INSTITUTIONAL FACTORS AFFECTING WATER RESOURCE DEVELOPMENT IN THE LOWER RIO GRANDE VALLEY, TEXAS,
Texas A and M University, College Sta, Texas Agricultural Experiment Station.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00676

6F. Nonstructural Alternatives

DESIGN AND CONSTRUCTION OF A DUAL RECHARGE SYSTEM AT MINOT, NORTH DAKOTA,
U S Geological Survey, Bismarck, North Dakota.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00433

CONFLUENCE ANALYSES OF LAND SURFACES,
Wyoming Univ., Laramie, Eng. Coll.
Michael R. McGaw.
Water Resour Res Inst, Water Resour Series 7, Univ Wyoming, Aug 1967. 49 p, 21 fig, 4 tab, 3 ref. OWRR Project A-001-Wyo.

Descriptors: Analysis, Coordination, Data storage and retrieval, Documentation, River basins, Watersheds (Basins).

A systematic method of deriving a set of regional coordinates is proposed for coordinating water resource activities. It analytically sub-divides a continent into those successively smaller-order confluent and multifluent regions in which surface waters are naturally interrelated. Possible applications of the system, together with resulting surface-water coordinates for the state of Wyoming are presented.
W69-00671

6G. Ecologic Impact of Water Development

PROCEEDINGS SYMPOSIUM ON ESTUARINE ECOLOGY COASTAL WATERS OF NORTH CAROLINA.
North Carolina Univ., Chapel Hill, Water Resour. Res. Inst.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-00460

07. RESOURCES DATA

7B. Data Acquisition

ELECTROMAGNETIC MAPPING OF HAWAIIAN LAVA TUBES,
Hawaii Univ, Manoa.
David von Seggern, and William M. Adams.
Tech Rep 8, Water Resour Res Center, Univ Hawaii, Aug 1968. 27 p, 13 fig, 9 ref. OWRR Project B-005-Hi.

Descriptors: Electromagnetic waves, Radio waves, Hawaii, Surveys, *Geologic mapping, Geological surveys, Subsurface investigations, Hazards, Subsurface waters, *Lava.
Identifiers: *Electromagnetic surveying, *Lava tubes.

A portable, electromagnetic loop-coupling device has been built to locate points on the earth's surface over points in an underground cavity and determine the depth to the cavity. This method requires both an underground and a surface operator who each carry a motorcycle battery, a 20-in.-dia loop antenna, and a compact transceiver circuit. The underground unit transmits to the surface a 1200 hz signal, essentially unattenuated and undistorted. The surface operator locates the transmitter by a nulling procedure. Three methods of determining depth are described. The accuracy of the location and the depth determination with the loop-coupling device is checked with a transit survey. The device was applied with success to Kaumana Lava Tube on the island of Hawaii. Locations confirmed suspicions that the tube ran under roads and buildings. The roof of the tube was found to average about 25-ft thick. Accuracy of a compass-and-tape survey 4400 ft into the tube was checked by locations with the loop-coupling method and found to be in error by 20 ft. Lava tubes are significant as conduits of water and as geologic hazards.
W69-00403

MEASUREMENT OF PRECIPITATION OVER LAKE MICHIGAN,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 02B.
For abstract, see .
W69-00406

BRIDGER TELEMETRY COMMUNICATIONS SYSTEM,
Montana State Univ., Bozeman, Water Resour. Res. Center.
Robert. A. Leo.
Rep 5 of Proj 779 (See W69-00453 and W69-00454), Jan 1967. 23 p, 13 fig. OWRR Proj B-006-Mont.

Descriptors: *Telemetry, *Communication, Electronic equipment, Data transmission, Instrumentation, *Radio communication systems, Antennas, Maintenance, Montana, Research facilities, Frequency modulation, Experimental data.
Identifiers: Bridger Data Center, Mont.

The Bridger Telemetry Communications System provides Frequency Modulation (FM), Very High Frequency (VHF), radio equipment in order to transmit digital hydrometeorological data from the Bridger Mountain area north of Bozeman, Montana, to the Electronics Research Laboratory on the campus of Montana State University, Bozeman, Montana. Either voice or data mode may be used. The voice mode may be used to communicate in both directions over the link for maintenance purposes and in normal operation is very seldom used. The data mode provides for transmission on 171.9 MHz of digital data in 1 direction only--from Bridger to ERL. The system accepts digital data (gathered and processed by other Bridger area equipment and facilities, and described in other reports) in the Transmitter Control Unit located at the Bridger Recording Center. This report lists events regarding the system; a description of the individual units; a description of the field-strength measurement experiments; plus an appendix consisting of block diagrams, schematics, and experimental data.
W69-00452

BRIDGER HYDROMETEOROLOGICAL RESEARCH AREA AND FACILITIES,
Montana State Univ., Bozeman, Water Resour. Res. Center.
For primary bibliographic entry see Field 09C.
For abstract, see .
W69-00453

BRIDGER HYDROMETEOROLOGICAL DATA ACQUISITION SYSTEM,
Montana State Univ., Bozeman, Water Resour. Res. Center.
Lee E. Cannon.
Rep 6 (Joint Rep 779) (See W69-00452 and W69-00453), Feb 1967. 39 p, 4 fig, 8 drwgs, 26 ref. OWRR Proj B-006-Mont.

Descriptors: On-site data collections, *Electronic equipment, *Data collections, *Data transmission, Meteorological data, Operations, Digital recording systems, *Instrumentation, Calibrations, Transducers, Computer programs.
Identifiers: Digitizers, Scanning.

The Data Acquisition system (DAS) installed at Bridger Bowl was designed and constructed to record a wide variety of hydrometeorological parameters in a computer compatible form. The DAS system is described in detail giving characteristics, operating instructions, and complete information on all components. Appendices offer illustrations and drawings of the terminal board functions, system cabling, and schematics.
W69-00454

WATER-LEVEL PROBE,
National Reactor Testing Station, Idaho Falls, Ida.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00591

A VERSATILE, GAS-OPERATED WATER-LEVEL RECORDER,
Institute of Northern Forestry, Juneau, Alaska.
A. E. Helmers.
Water Resour Res, Vol 4, No 3, pp 619-623, June 1968. 5 p, 4 fig.

Descriptors: *Liquid level gages, Instrumentation, Costs, Gases, Rain gages, Measuring instruments, *Bubbles, Hydrostatic pressures, Nitrogen, Wells, Pressure regulators, Recording systems, *Water stage recorders, Water table, Ground water, Piezometers, Sensors.
Identifiers: *Bubbler system, Water level, Probes (Instruments), Water wells.

A low-cost, gas-operated, water-level recorder is described. The device operates on the basis that the pressure required to bubble gas freely through a liquid is a function of depth. Commercially available gas-operated, water-level recorders are expen-

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sive; parts and materials for the described recorder cost less than $200. Water level changes of 0.05 in. can be detected in the laboratory, and under field conditions the maximum sensitivity is 0.1 in. Recorders of this type are highly successful for measuring water levels in piezometers and storage precipitation gages, and appear adaptable to recording stream stages and ground-water levels. (USBR)
W69-00597

BRIDGER INSTRUMENT MODIFICATION,
Montana State Univ., Bozeman.
Duain Bowles.
Water Resour Res Center Rep 2, Sept 1966. 30 p, 15 fig, 2 tab. OWRR Project B-006-Mont.

Descriptors: Instrumentation, *Measuring instruments, Thermometers, Calibrations, Potentiometers, Gages, *Water levels, *Rain gages, Equipment.

The instrument modifications described in this report are intended for use in the Water Resources Bridger Data System. Specifically, the modifications were designed to permit electrical interrogation of existing devices now being operated at the research area. The modifications were to provide a resistive readout of 10 K ohms or operate as a potentiometer. Ideally the modifications would not degrade instrument performance and would permit operation of the instrument as a direct analog recording device. Modifications were designed for operation on the Belfort Universal Raingage, the Leopold Stevens Water Level Recorder, and the Belfort Recording Microbargraph. In addition, thermistor thermometers were constructed to operate at the research areas thermograph locations. Calibration tests were conducted to verify that the instrument modifications met the design requirements.
W69-00643

METHOD OF VOLUME-DIVERSION ANALYSIS OF A STREAM,
U S Geological Survey, Washington, D. C., Water Resources Division.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00694

LABORATORY EVALUATION OF SELECTED RADIOISOTOPES AS GROUND-WATER TRACERS,
Texas A and M University, College Station, Texas.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00701

7C. Evaluation, Processing AND Publication

MAP INTERPRETATION AND CLASSIFICATION OF BURIED VALLEYS,
Massachusetts Univ, Amherst.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00437

THE USE OF EIGENVECTORS FOR CLIMATIC ESTIMATES,
Nevada Univ., Reno.
Charles K. Stidd.
Univ Nevada, Desert Res Inst, Preprint Series 36, July 1966. 28 p, 4 fig, 4 tab, 6 ref. OWRR Project B-008-Nev.

Descriptors: Estimating equations, Probable maximum precipitation, Hydrologic cycle, *Approximation method, Reliability, *Mathematical models, Precipitation (Atmospheric), Climatology.
Identifiers: *Eigenvectors, *Orthogonal functions, Precipitation estimates.

Eigenvectors have an advantage over mathematical orthogonal functions in that they are derived from the data being studied and strongly resemble the important features of the data. The process is described by which a matrix of eigenvectors was derived from the sets of 12 mean monthly precipitation values for 60 stations in Nevada. The first 3 eigenvectors (in order of importance) were found to account for 93% of the variance in the original 12 x 60 matrix of raw data and are also found to have features in common with 3 natural cycles of annual precipitation in Nevada. The station multipliers, corrected to a mean elevation, are plotted and analyzed on 3 maps. The method is tested by using it to estimate long-term means for a period of time not included in the input data. Standard errors using the maps and eigenvectors are smaller than for estimates based directly on the short-term station means. Estimates for stations not used in the original input had standard errors small enough to be acceptable. It can be claimed that for a given point in Nevada, the eigenvector method will give as reliable an estimate of the 12 monthly average precipitation amounts as could be obtained from an actual 10-yr record.
W69-00644

08. ENGINEERING WORKS

8A. Structures

UNITED STATES V GRAND RIVER DAM AUTHORITY (FEDERAL FLOOD CONTROL UNDER COMMERCE CLAUSE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00470

AUTOMATED ANALYSIS OF GRID BEAM SYSTEMS,
Iowa State Univ, Ames.
Hotten A. Elleby.
Eng J Amer Inst Steel Constr, Vol 5, No 3, pp 123-127, July 1968. 5 p, 3 fig, 2 tab, 1 chart, 5 ref, append.

Descriptors: Flow diagrams, *Stress analysis, Structural engineering, *Structural analysis, Structural design, Structural members, Boundaries, *Automation, Beams, Moments, Shear stress, Continuous beams, Continuous structures, Programs, *Grid systems, Trusses, Optimum design, Computer programming, Deformation.
Identifiers: Matrix methods (Structural), Computer programs, Boundary Conditions.

An exact solution to a beam grid system can be obtained using Clapeyrons 3-moment equation which can be derived from slope deflection equations. Two unknown quantities per node point are required for the general solution rather than 3 for slope deflection equations. Two boundary conditions are considered: a free boundary where beams are used to support interior members, and a grid system that is continuous over interior supports. The method is divided into 3 phases to simplify computer input. Analysis of a uniformly loaded grid roof system supported at the corners illustrates the use of this method. The method was developed for beam-type members such as wide-flange sections of plate girders, but 2-way truss analysis is responsive where the upper and lower chords are continuous sections and the shearing deformation of the trusses is known to be negligible. A flow chart for the computer program is given. (USBR)
W69-00576

HYDRAULICALLY CONTROLLED BUTTERFLY GATES IN FARM LATERAL TURNOUTS FOR AUTOMATION OF SURFACE IRRIGATION SYSTEMS,
Howard R. Haise, E. Gordon Kruse, and Leonard Erie.
Pap 68-244, Amer Soc Agr Eng 1968 Annu Meet, Logan, Utah, June 1968. 14 p, 12 fig, 5 ref.

Descriptors: *Turnout gates, *Automatic control, Irrigation practices, Irrigation systems, *Laterals, *Gates, *Butterfly valves, Automation, Hydraulic gates and valves, Floats, *Ditches, Plastic tubing, *Surface irrigation.
Identifiers: Farms, Arizona.

An automatic irrigation system was used experimentally to irrigate 10 ac of citrus grown on the coarse-textured Superstition fine sand on the Yuma Mesa in Arizona. A major objective in designing the system was the use of existing farm laterals and turnouts, adapting automated features to them at the lowest cost. The automatic system consists of (1) a source of water at 60-70-psi pressure, (2) solvent-welded 3/4-in. PVC pipe to distribute the water under pressure at selected locations along the farm lateral, (3) 4-way hydraulically controlled pilot valves operating double-acting water cylinders to open and close butterfly gates in turnouts, and (4) sumps with sinking floats to operate 3-way control valves when surface inflow of irrigation water occurs at a predetermined point within the border strip. The automatic system is completely hydraulic, deriving its operating pressure from a pump driven by a water wheel mounted in the flowing water used to irrigate the land. (USBR)
W69-00588

8B. Hydraulics

TWO DIMENSIONLESS GROUPS RELEVANT IN THE ANALYSIS OF STEADY FLOWS OF VISCOELASTIC MATERIALS,
Delaware Univ., Newark, Chem. Eng. Dept.
Gianni Astarita.
I and EC Fundamentals, Vol 6, pp 257-262, May 1967. 6 p, 25 ref. OWRR Project A-005-Del.

Descriptors: *Steady flow, Analysis, *Two-dimensional, *Viscous flow.
Identifiers: *Viscoelasticity, Flow patterns.

Five flow patterns (viscometric flow, pure shear, elongational flow, fourth-order flow, and a superposition of the first two) are analyzed. The behavior of fluids characterized by an essentially exponential rate of stress relaxation in such flows is discussed. The discussion leads to the introduction of 2-dimensionless groups relevant for steady flows.
W69-00626

FLOW OF VISCOELASTIC FLUIDS THROUGH POROUS MEDIA,
Delaware Univ., Newark.
R. J. Marshall, and A. B. Metzner.
I and EC Fundamentals, Vol 6, No 3, pp 393-400, Aug 1967. 8 p, 3 fig, 1 tab, 50 ref. OWRR Project A-005-Del.

Descriptors: Bibliographies, *Viscous flow, Flow, *Porous media, Experimental data, *Fluid friction, Flow resistance, Permeability, Analysis.
Identifiers: *Viscoelasticity, Deborah number, Test results.

This work was undertaken to define the conditions under which the Deborah number may become large enough to cause significant deviations from the usual drag coefficient-Reynolds number relationships for purely viscous fluids flowing through porous media under noninertial conditions. The analysis suggests that major effects may be expected at Deborah numbers from 0.1 to 1.0. Experimental studies, using a porous medium, support this analysis and yield a critical value of the Deborah number at which viscoelastic effects were first found to be measurable. Influences of a high Deborah number level upon the uniformity of the flow and upon the distribution of the fluid residence times in porous media are considered.
W69-00627

HYDRAULIC MODEL STUDY OF NONSTEADY FLOW TO MULTIAQUIFER WELLS,
Princeton Univ., New Jersey.

For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00629

HYDRAULIC MODEL STUDY OF NONSTEADY FLOW TO MULTIAQUIFER WELLS,
Princeton Univ., Princeton, N. J.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00630

A NUMERICAL SOLUTION OF THE EQUATIONS OF MOTION AS APPLIED TO SURFACE FLOW,
New Mexico State Univ., University Park.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00636

8C. Hydraulic Machinery

RECENT PROGRESS IN THE FIELD OF SYNTHETIC TESTING OF CIRCUIT-BREAKERS,
P. Heroin, J. C. Henry, and C. Marty.
Pap 13-11, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 19 p, 17 fig, 10 ref.

Descriptors: *Circuit breakers, *Test procedures, Extra high voltage, Statistics, Test facilities, Stress, Experimental data, Characteristics, Probability, Electric currents, Electric potential, Fluorides, Research and development, Electric arcs, Mathematical analysis, Sulfur compounds, Performance tests, Dielectrics.
Identifiers: *Airblast circuit breakers, *Synthetic test methods, Test results, France, Foreign research, Short circuits, *Sulfur fluorides.

With transmission voltages becoming higher and higher, new methods are required for testing circuit breakers at these higher voltages and currents. Research has been undertaken in France to develop and explore the current injection synthetic test methods and to gain better knowledge of circuit breaker phenomena. Numerous statistical tests were performed on two types of circuit breakers (airblast and sulfur hexafluoride) to compare direct testing methods with synthetic testing methods. The general methodology for testing circuit breakers is discussed. Results of asymmetrical current tests on an airblast circuit breaker are given. A satisfactory method is described for prolonging the test beyond the first zero. Phenomena related to high and low restriking during shortcircuit tests on a sulfur hexafluoride circuit breaker are studied. Investigations of the low probability of the reignition point showed that the percentage of reignitions at the first zero obeyed a Gaussian law for percentage values between 0.6 and 95%. Synthetic tests were concluded to be the best method for testing airblast and sulfur hexafluoride circuit breakers. (USBR)
W69-00570

NEW EXPERIENCES DURING EIGHT YEARS OF TOWER TESTING AT THE LECCO STATION (ITALY),
Societa Anonima Elettrificazione SpA, Milan, Italy.
M. Finzi, and G. Magenta.
Pap 22-03, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 7 p, 6 fig, 1 tab.

Descriptors: Structural analysis, *Transmission towers, Design tools, *Design criteria, Test procedures, *Test facilities, Experimental data, Steel structures, Aluminum alloys, Compression, *Towers, Dynamometers, Fabrication, Live loads, Dead loads, Tolerances (Mechanics), Extra high voltage, *Guyed towers.
Identifiers: *Test results, Testing equipment, Testing, Loading tests, *Lecco Station, Italy, Foreign research, Slenderness ratio.

Experience gained during the past eight yr of transmission tower testing at Italy's Lecco test station is reported. The test station and facilities for testing ehv towers are described. Results of tests on guyed and aluminum towers are discussed. Compression formulas proposed by the American Society of Civil Engineers in its Aug 1967 report 'Electrical Transmission Line and Tower Design Guide' have been verified experimentally. The verification ascertains the correctness of the proposed formulas and the high success probability of load tests performed on structures designed according to the ASCE design criteria. (USBR)
W69-00571

FIVE-YEAR RESEARCH PROGRAM IN ULTRA-HIGH VOLTAGE,
General Electric Co, Schenectady, N Y; Pennsylvania Electric Co, Jamestown.
L. O. Barthold, and P. L. Lumnitzer.
Pap 42-04, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 7 p, 4 fig, 1 tab.

Descriptors: Transmission towers, *Contamination, Corrections, *Extra high voltage, Research and development, Test facilities, *Transmission lines, Test procedures, Design, Instrumentation, *Radio interference, *Electrical coronas, Electric insulation, Laboratory tests, Lightning, Losses, Transmission (Electrical).
Identifiers: *Ultra high voltage, Electrical insulators, Switching surges, Electrical design, Testing equipment, Electric conductors.

Significant conclusions reached at Project EHV in Pittsfield, Mass, during the 1965-66 ehv program are described, and the facilities and program for extending this research to voltage levels up to 1500-kv ac are outlined. New information cited includes: (1) switching surge strength of insulator-tower configurations, (2) air-density and humidity correction factors for long insulator assemblies, and (3) electrical strength of contaminated insulators. The 1967-71 program will initially use cages to simulate the field surrounding short sections of ultra-high-voltage conductors. A single-phase transformer will be used in 1969 to energize full-scale conductor and insulator configurations suitable for voltages of 1000 to 1500 kv. Testing of artificially and naturally contaminated insulators will include superposition of switching surges on 60-cycle voltage. Ultra-high-voltage systems of 1000 to 1500 kv technically are feasible for overlay of 500- and 765-kv systems; however, economic application will depend on refinements and innovations in transmission design such as form the objectives of the Project Ultra-High Voltage Program. (USBR)
W69-00572

CORONA IN POWER TRANSFORMERS,
Industrie Elettriche di Legnano, Italy; McGraw-Edison Power System Division, Milwaukee, Wis; Ferranti Ltd, Great Britain.
S. Yakov, C. C. Honey, and A. B. Madin.
Pap 12-06, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 11 p, 9 fig, 6 tab, 13 ref.

Descriptors: *Power transformers, *Electrical coronas, Oscillographs, Detection, *Electric insulation, Methodology, Instrumentation, Research and development, Radio interference, Static electricity, Dielectrics, Ultrasonics, Measurement, Laboratory tests, Electrical engineering, Oils.
Identifiers: Protection (Electrical), Insulating oil, Insulation, Dielectric properties.

Detection methods capable of indicating small partial discharges in complex insulation structures of power transformers during dielectric tests are available to manufacturers and users. Experiments are presented using three widely publicized corona detecting techniques: (1) the NEMA Noise Meter for measuring changes in voltage, (2) the charge detector for measuring charge displacement, and (3) the ultrasonic detector for measuring acoustic disturbances. A summary is given of test data obtained on samples and models of transformer insulation structures. These data may answer some questions relative to corona in transformers. Many problems remain unsolved and the answers will come only through publication and discussion by the industry of test results. (USBR)
W69-00573

TRANSIENT VOLTAGES CAUSED BY THE OPERATION OF CIRCUIT-BREAKERS IN HIGH-VOLTAGE SYSTEMS: SWITCHING OVERVOLTAGES WHEN CLOSING LINES AT NO-LOAD AND TRANSIENT RECOVERY VOLTAGES WHEN INTERRUPTING FAULTS CLOSE TO TRANSFORMERS.
Brown Boveri and Co, Baden, Switzerland; Sprecher and Schuh, Aarau, Switzerland.
H. Glavitsch, E. Ruoss, and R. Thaler.
Pap 13-05, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 14 p, 12 fig, 2 tab, 4 ref.

Descriptors: Extra high voltage, *Circuit breakers, Transients, Power transformers, Test procedures, *Transmission lines, Networks, Frequency, Faults (Electrical), Investigations, Electrical impedance, Stress, Test facilities, Electric potential.
Identifiers: *Switching surges, *Overvoltage, Switzerland, Flashover, *Short circuits, Overhead ground wire, Foreign research.

The problems concerning high-voltage circuit breakers discussed have more significance with the increase of rated voltage and short-circuit capacity of high-voltage networks. An understanding of these problems is essential for economic design of high-voltage systems and equipment. The first problem concerns the overvoltages that occur when energizing a transmission line at no-load by a circuit breaker. The influence of different network and line parameters on the magnitude of switching surges is shown, and the frequency of overvoltage occurrence depending on different circuit breaker parameters is examined. Nonsimultaneous closing of the 3 poles of a circuit breaker is considered. Voltages of lines studied were 245-, 420-, and 765-kv. The second problem involves transient recovery voltage and natural frequencies when interrupting a short circuit at the terminals of a circuit breaker, the fault being fed from a network by transformers. Recovery voltages with frequencies up to 30 khz and an amplitude factor of 1.8 to 1.9 may occur. A recommendation is given for laboratory simulation of this stress on a circuit breaker during test. (USBR)
W69-00574

DEVELOPMENT OF ROTATING RECTIFIER EXCITERS,
UCE Linalux-Hainaut, Belgium; Ateliers de Constructions Electriques de Charleroi, Belgium.
P. Robert, P. Bawin, and J. Dispaux.
Pap 11-05, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 17 p, 17 fig, 6 tab, 4 ref.

Descriptors: *Excitation, *Semiconductors, Magnetic fields, Leakage, Design, *Rectifiers, Electric power, Electric currents, Electric fields, Electrical stability, *Electric generators, Electric potential, Direct currents, Alternating currents, Losses.
Identifiers: Leakage current, *Rotating machines, *Electrical design, Foreign research, Belgium, Flux density, Harmonics, Machine design.

Several aspects of exciter design using semiconductor rectifiers are analyzed. Machine design and methods for reducing differential leakage and stray load losses in windings are discussed. This analysis is conducive to the study of the classical star-connected 3-phase windings and polygonally connected windings with a higher number of phases. A comparison of different possibilities is made using tables, curves, and winding arrangements. The definition of exciter speed of response has been adapted to take into account the influence of armature reaction; this variation has been examined as a function of the number of poles and of various design parameters. Time constants for rotating rectifier exciters are similar to those for d-c exciters

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of the same speed, and considerably lower than those for exciters used on large a-c generators. Manufacturers have several methods at their disposal to overcome problems of differential leakage, supplementary losses, and attendant voltage drops. (USBR)
W69-00575

IMPORTANCE OF FRETTING IN VIBRATION FAILURES OF STRANDED CONDUCTORS,
Alcoa Research Laboratories, New Kensington, Pa and Massena, N Y.
William G. Fricke, and Charles B. Rawlins.
Inst Elec Electron Eng Trans Power App Syst, Vol PAS-87, No 6, pp 1381-1384, June 1968. 4 p, 6 fig, 8 ref.

Descriptors: *Fatigue (Mechanics), *Failure (Mechanics), *Vibrations, Corrosion, *Transmission lines, Tensile stress, Test procedures, Oxides, Test specimens, Laboratory tests, Spectroscopy, Coatings, Films, Cracks, Investigations, Aluminum alloys, Abrasion, Friction.
Identifiers: *Fretting, *Electric conductors, Aeolian vibration.

Surface fretting between conductor strands and support hardware plays an important part in conductor fatigue failures initiated by aeolian vibration. Examination of conductor strand failures from lines in service and from laboratory spans shows that fatigue cracks originate at fret marks in all cases. Laboratory fatigue tests indicate that fretting causes a reduction in fatigue strength of conductor strands, below that of unfretted wires, by a factor of 1.6. Test procedures are explained and results of metallographic examination of 23 laboratory fatigue test specimens and 7 in-service failures are discussed. Fretting effects can be reduced by applying surface coatings, but their permanence remains undetermined. (USBR)
W69-00579

CONSIDERATIONS IN PLANNING FOR RELIABLE ELECTRIC SERVICE,
General Electric Co, Schenectady, N Y.
Charles Concordia.
Inst Elec Electron Eng Sprectrum, Vol 5, No 8, pp 71-76, Aug 1968. 6 p, 3 fig, 5 ref.

Descriptors: Electric power, *Reliability, Design, Planning, *Electric power production, *Transmission (Electrical), Disturbances, Frequency, *Power system operations, Electric relays, Faults (Electrical), Loads.
Identifiers: *Load shedding, *Load-frequency control, Interconnected systems, Tie lines, Outages, Operating criteria, Load flow.

Satisfactory levels of reliability of bulk-power generation transmission systems depend on sound principles of planning, design, and operation, rather than revolutionary changes. To assure this reliability, it requires effective transmission and adequate interconnections, adherence to operating limitations, and recognition that an unforeseen contingency will cause system separation and generator deficiency. The first consideration requires system studies to demonstrate that no single disturbance will cause cascading tripouts of lines or generators; the second may be facilitated by automatic monitoring of the system condition; and the third requires automatic load shedding on low frequency. Designing and operating principles required for satisfactory service reliability are summarized. The stages of system planning for determining proper system design and required transmission and generation capacity are outlined. System operating limits and system splitup are discussed. (USBR)
W69-00598

MAJOR HYDROELECTRIC POWER PLANTS IN TEXAS: HISTORICAL AND DESCRIPTIVE INFORMATION,
Texas Water Development Board, Austin, Texas.
F. A. Godfrey, and C. L. Dowell.
Tex Water Develop Board Rep 81, 93 p, Aug 1968. 28 fig, 22 tab, 10 ref.

Descriptors: *Data collections, *Hydroelectric plants, *Texas, Dams, Electric power production, Engineering structures, Water rights, Water utilization.
Identifiers: *Electrical energy generation.

Descriptions of the 25 major hydroelectric powerplants in Texas are given chronologically to show their historical development to Jan 1, 1968. Records of electrical energy generated at each plant follows the plant description. Included are descriptions of 4 plants which are no longer in operation. Information on the water rights applicable to each powerplant is presented. Photographs of some of the plants are included. No description is given of the many small hydroelectric plants used by early settlers to operate grain mills, cotton gins, saw mills, water pumps, and other equipment. These are described in 'The Water Power of Texas' (Taylor, T W, 1904). (Lang-USGS)
W69-00692

8D. Soil Mechanics

DADE COUNTY, FLORIDA (BEACH EROSION CONTROL AND HURRICANE PROTECTION).
Army Corps of Engineers, Washington, D. C.
For primary bibliographic entry see Field 02J.
For abstract, see .
W69-00441

NONLINEAR FLOW THROUGH GRANULAR MEDIA,
Imperial College of Science and Technology, London, Great Britain.
David Ellis Wright.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY4, pp 851-872, July 1968. 22 p, 9 fig, 1 tab, 23 ref, 3 append.

Descriptors: *Granular materials, *Flow, *Fluid flow, Anemometers, Hot wire anemometers, Reynolds number, Flud friction, Unsteady flow, Steady flow, Velocity, Turbulence, Laboratory equipment, Laboratory tests, Air, Gravels, Sands, Permeameters, Boundary layer, Hydraulics, Bibliographies.
Identifiers: Foreign research, Great Britain, Resistance coefficients, Darcys law.

Relative roles of steady and unsteady fluid motion in causing deviation from the linear Darcy resistance law are described. Air velocities and turbulence intensities were measured within the pores of a gravel bed by hot-wire anemometers. Results indicate that although the linear resistance relation ceases to be valid at a Reynolds number of 2, velocity fluctuations do not begin until the Reynolds number is 100, and turbulence is not fully established until the Reynolds number is 800. Studies of waterflow through a coarse sand bed show that convergence of the macrostreamlines significantly reduces the resistance at Reynolds numbers over 10, the proportionate reduction increasing with flow. Observations are interpreted in terms of flow through coiled pipes or around immersed objects; 4 regimes of flow through granular media are proposed. (USBR)
W69-00577

FLOW AROUND A VERTICAL SHEETPILE EMBEDDED IN AN INCLINED STRATIFIED MEDIUM,
Northwestern Univ, Evanston, Ill.
Raymond J. Krizek, and Vera B. Anand.
Water Resour Res, Vol 4, No 1, pp 113-123, Feb 1968. 11 p, 7 fig, 23 ref, append.

Descriptors: *Flow, *Fluid flow, *Sheet piling, Stratification, Porous materials, *Permeability, Anisotropy, *Seepage, Bibliographies, Models, Laboratory equipment, Laboratory tests, Hydraulic models, *Groundwater flow, Sandstone, Flow nets.
Identifiers: *Flow around objects.

The steady-state flow around a vertical sheetpile embedded in an inclined stratified porous medium underlain by an impervious boundary is studied experimentally. The porous medium is a synthetic sandstone composed of alternating thin layers of 2 sand-epoxy mixtures with different coefficients of permeability. The problem is subjected to a coordinate transformation by considering the layered system as homogeneous and anisotropic; a graphical flow net solution is obtained for the streamlines, potential distribution, and flow quantity. The complex variable theory and conformal mapping techniques are used to obtain an approximation for flow quantity and exit gradient variation. Experimental results on streamlines, potential distribution, flow quantity, and exit gradient were obtained from a model study, and exhibited variations from predicted theoretical results, especially in flow quantities. A systematic study of experimental errors suggests that these variations cannot be attributed wholly to experimental sources and implies that the effective permeability of a stratified porous medium cannot be determined by considering the system as homogeneous and anisotropic. (USBR)
W69-00584

SOIL DYNAMICS,
Auckland Univ, New Zealand.
P. W. Taylor.
N S Eng, Vol 23, No 6, pp 225-229, June 1968. 5 p, 4 fig, 22 ref.

Descriptors: *Loading time, Loads, Loading rate, *Live loads, Seismic waves, Earthquakes, Soil tests, Soil stability, Microstructures, Soil physical properties, Soil structure, Oscillation, Rheology, Sands, Soil mechanics, Liquefaction, Cohesive soils, Granular materials, *Dynamics, Moisture content, Clays, Bibliographies, *Soils.
Identifiers: *Soil dynamics, Earthquake loads, Dynamic response, Dynamic tests, Dynamic loads.

Soil dynamics is concerned with rapidly varying stresses in a soil mass. The relationship between soil dynamics and applied sciences of rheology, geophysics, and seismology is discussed. Three types of time-dependent stress conditions are considered in soil dynamics: (1) transient--a single pulse that reaches a maximum quickly and may cause failure; (2) repeated--may not cause failure immediately but may alter soil properties and cause failure eventually; and (3) oscillatory--varies roughly sinusoidally with time. Transient loading tests on clays show that strength and modulus of deformation increase with rate of strain. Rate of strain has little effect on properties of granular materials under transient loading. Repeated loading of some clays increases the ultimate strength as much as 3 times its original value. Oscillatory loading may result from artificial (machine vibrations) and natural (earthquakes) sources. Granular materials having the proper degree of saturation and density may liquefy and lose shearing resistance when subjected to oscillatory loading. Tests show that cohesive soils may fail after several cycles at a stress much below short-duration transient or static values. (USBR)
W69-00586

SELECTION OF ANALYTICAL METHODS AND STRENGTH PARAMETERS FOR SLOPE STABILITY INVESTIGATIONS IN COHESIVE SOILS,
Idaho Univ, Moscow.
Robert L. Schuster.
Highway Res Rec, No 223, 1968. 8 p, 4 fig, 4 tab, 18 ref.

Descriptors: Slopes, *Stability analysis, *Cohesive soils, Cohesion, Clays, Shear strength, Embankments, Pore pressures, Cut slopes, Internal friction, Failure (Mechanics), Consolidation, Overconsolidation, Strain, Shear tests, Effective stress, Total stress, Fissures, Bibliographies, Soil mechanics, Cuts.
Identifiers: Failures, Failure surfaces, Strain rate, Soil properties, *Slope stability, Slip surface, Bishops method, Slip-circle method.

Case histories of slope failures in clays are reviewed to aid in selecting the proper shear strength parameters and methods of stability analysis. The phi equals zero total stress method is satisfactory for short-term stability analysis of nonfissured clays. The phi equals zero analysis is not safe for short-term stability of fissured, overconsolidated clays unless the reduced strength due to the presence of fissures is considered. When working with overconsolidated clays, the rate at which the undrained shear test is conducted has considerable effect on the laboratory undrained shear strength, and the undrained shear strengths obtained in the common 15-minute test may be higher than those in the slope at failure. Analysis on an effective stress basis is preferable to the phi equals zero total stress analysis for long-term stability of slopes in nonfissured clays. Bishops method results in better analyses than the conventional method of slices that produces factors of safety for the failure state that are 15-20% too conservative. Effective stress methods of analysis should be used for long-term stability of slopes in overconsolidated clays containing fissures or other discontinuities. (USBR)
W69-00590

LABORATORY INVESTIGATION ON THE USE OF HIGH MOISTURE CONTENT SOILS IN HIGH FILLS,
Kentucky Univ, Lexington; Virginia Highway Research Council.
Y. H. Huang, and F. D. Shepard.
Highway Res Rec, No 223, pp 45-59, 1968. 15 p, 7 fig, 3 tab, 11 ref.

Descriptors: *Moisture content, *Embankments, Soils, *Shear strength, Consolidation, Direct shear, Thixotropy, Silts, Loams, Test procedures, Compaction, Saturation, Shear tests, Soil physical properties, Density, Cost comparisons, Void ratios, Soil mechanics, Pore pressures, *Fills, Test specimens, Compaction tests.
Identifiers: Soil density, Test results.

Dunmore silt loam and Clarkesville clay loam were used to investigate the effects of high moisture-content soils in high fills. Soil specimens were fabricated by static compaction and investigated by direct shear and conventional consolidation tests. The soil did not exhibit thixotropic behavior under given test conditions. Shear strength increased with consolidation pressure, the rate of increase being greater at lower densities. Initial density had the greatest effect on shear strength when soils were not subjected to consolidation. Regardless of initial density and strength, soils subjected to high consolidation pressures would arrive at some density and strength that were only slightly different. Based on the assumption that density is the most important factor affecting strength and on Terzaghi's theory of consolidation, a procedure is suggested to determine the depth below which wet soils would be placed and the length of drainage path required to effect a given degree of consolidation. A cost analysis must be conducted before any decisions on using high moisture-content soils are made. Handling wet material and installing drainage may be more expensive than importing borrow material. (USBR)
W69-00599

CALCULATION OF DEEP SUPPORTS IN TERMS OF DEFORMATIONS,
Kh R. Khakimov.
Soil Mech Found Eng, No 6, pp 402-406, Nov-Dec 1967. 5 p, 3 fig, 1 tab, 4 ref. Transl from Russ, Osn, Fundamenty i Mekh Gruntov, No 6, pp 14-17, Nov-Dec 1967.

Descriptors: *Foundations, Cast-in-place structures, Piles, Analysis, Pile foundations, *Supports, Elastic deformation, Plastic deformation, Strain, Stress-strain curves, Settlement, Shear failures, Consolidation, Shear strength, Footings, Soil physical properties, Poisson ratio, Soil mechanics.
Identifiers: Foundation modulus, Deep footings, Foreign research, USSR, Deformation modulus.

The design of deep foundations can be expedited by using deformations involving the linear relation between stress and strain. However, designs considering the nonlinear relation of stress and strain are needed for better use of soil resistance and to lower foundation costs. Separate determination of settlements caused by soil consolidation and by development of a shear zone is proposed. In 1 case the settlement resulting from consolidation was 19.9 cm and 1.1 cm from shear, or 6%. Simplified calculations of deformation for deep supports (large cast-in-place piles) require consideration of 2 factors: (1) The relation between stress and strain is nonlinear, causing the modulus of soil deformability to be variable. (2) Strain is composed of permanent set and elastic strain, the first being greater. Equations are presented for the deformability modulus, limits of proportionality, nonlinear deformability of soil, and strain. A table lists 11 sets of tests on different soils. The analysis accommodates soil resistance beyond the limits of linear stress-strain relation and permits increasing the load on the supporting soil by a factor of 1.4 to 2. (USBR)
W69-00609

A REVIEW OF RECENT RESEARCH ON STRENGTH AND CONSOLIDATION OF SOFT SENSITIVE CLAYS,
University of Toronto, Canada.
T. Cameron Kenney.
Can Geotech J, Vol 5, No 2, pp 97-119, May 1968. 23 p, 12 fig, 3 tab, 43 ref.

Descriptors: *Shear strength, Shear forces, *Shear resistance, Failure (Mechanics), Shear stress, *Clays, *Consolidation, Deformation, Internal friction, Cohesion, Sampling, Clay minerals, Boundaries, Triaxial shear, Shear tests, Undisturbed samples, Laboratory tests, Shear strain, Direct shear, Soil mechanics, Preconsolidation, Bibliographies.
Identifiers: *Compressibility, Strain energy, At rest pressure, Bond, Secondary consolidation, Foreign research, Canada.

New concepts have been developed of strength and consolidation of soft sensitive clays. Shear strength and compressibility are measures of a soil's resistance to deformation but for different boundary conditions. These soil behaviors depend on shear resistance that can be developed at contacts between individual mineral particles. The coefficient of friction depends on mineralogy of the particles and degree to which particles are parallel oriented. Shear resistance of parallel-oriented, plate-shaped, clay minerals can be more than 30% less than for randomly oriented particles. Cohesion is caused by net attractive forces between adjacent particles (Van der Waal forces) and interparticle linkages formed by polarized ions. Undisturbed soft sensitive clay samples are impossible to obtain because stress changes that accompany sampling cause irrecoverable strains in the clay. Soft clays do not behave elastically when restressed to their in situ stresses; in situ behavior cannot be reproduced in the laboratory simply by reapplication of stress. Situations and reasons are given for the preconsolidation pressure being greater than the greatest overburden ever experienced by a soil. (USBR)
W69-00615

DESIGN AND CONSTRUCTION OF A HORIZONTAL VISCOUS FLOW MODEL,
Delaware Univ., Newark.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00628

SEEPAGE FLOW THROUGH AN EARTH DAM,
Georgia Inst. of Tech., Atlanta, Civil Engineering Sch.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00665

8E. Rock Mechanics AND Geology

STATIC LOADING ON THE SURFACE OF LAYERED MEDIA,
Columbia Univ, New York, N Y.
J. T. Kuo, G. Barla, and S. H. Boshkov.
Pap, Preprint No 68-AM-101, Annu Meet Amer Inst Mining, Met, Petrol Eng, New York, Feb 1968. 45 p, 10 fig, 1 tab, 7 ref.

Descriptors: Loads, Statics, *Underground structures, *Rock mechanics, Mining engineering, Mathematical analysis, Matrix algebra, Model tests, Stress, Structural models, *Stress analysis, Elasticity, Displacements, Structural analysis.
Identifiers: Boussinesq equation, Static behavior, Underground openings.

The Boussinesq solution to the problem of a normal static load on the surface of a half-space has wide application to loading problems in engineering. The generalized solution of an inclined static load on the surface of a multilayered half-space is applied to a system of randomly distributed inclined loads, simulating conditions of circular pillar loading in a mine. Inclined loads are assumed to be a linear combination of a normal load and an asymmetrical shear load. Such loads may arise from applied displacements, applied stresses, or combinations of both. Each layer is considered homogeneous and isotropic; layer interfaces are assumed perfectly welded. The problem is solved using the Thompson-Haskell matrix formulation which avoids the cumbersome nature of the problem and is easily adaptable to numerical evaluation. Stresses from a normal static load are calculated and compared with geletin model tests, simulating mining conditions of pillar loading on continuous horizontal-layered media. (USBR)
W69-00603

CRUSHED LIMESTONE BARRIERS: A BASIC FEASIBILITY STUDY IN THE NEUTRALIZATION OF ACID STREAMS,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00637

8F. Concrete

LARGE DIAMETER NONREINFORCED CAST-IN-PLACE CONCRETE PIPE,
Ernest C. Fortier.
J Amer Concr Inst, No 7, Proc V 65, pp 544-549, July 1968. 6 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Concrete pipes, Concrete placing, *Pipes, Construction, Pipelines, *Cast-in-place structures, Concrete, Irrigation, Structural analysis, Sewers, Costs, Construction costs, Cost comparisons, Trenches, Forms (Concrete), Field tests, Shoring, Excavation.
Identifiers: Sacramento Valley, Calif, Formwork (Construction), *Cast-in-place pipes, Construction equipment, Concrete properties.

Recent installations of large-diameter (60, 72, 84, and 96 in.) nonreinforced cast-in-place pipe have shown satisfactory performance. Continuous casting machines can be constructed for large pipe as easily as for small pipe if proper design and mechanization are used. Sacramento County, Calif, one of the early users of large pipe, made its first installation in 1955. Th County found that the principal advantage of cast-in-place pipe was to be found in 30 to 40% cost savings over conventional pipe. The continuous casting process developed by No-Joint Concrete Pipe Co is described. A separate slipform is required for each pipe size. Aluminum part-circle forms are used to support 230 deg of the inside of the pipe. In many respects large sizes facilitate rather than hinder construction of

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monolithic pipe by the continuous casting process. Compressive strength of concrete is specified as 3000 psi. Excavation is accomplished with back hoes or ladder-type excavators. Hardpan soils offer ideal conditions for monolithic pipe, but expansive soils must be expanded fully before concrete placement. Strength tests show that pipes up to 120 in. could be made to safely support earth and live loads normally encountered in irrigation systems, storm drains, and sanitary sewers. (USBR)
W69-00581

GUIDE FOR LOW DENSITY PRECAST CONCRETE FLOOR, ROOF, AND WALL UNITS,
Albert Litvin, L. E. Rivkind, and Leslie A. Barron.

J Amer Concr Inst, No 7, Proc V 65, pp 507-512, July 1968. 6 p, 1 tab, 17 ref.

Descriptors: *Lightweight aggregates, *Precast concrete, Deflection, Concrete testing, Slabs, Concrete technology, Prefabrication, Concrete, Perlite, Roofs, Walls, Structural design, Design data, Bibliographies, Thermal conductivity, Vermiculite, Shrinkage, Elasticity modulus, Curing, Acceptance tests, Floors.
Identifiers: *Lightweight concretes, Fire resistance.

Design and fabrication practices are outlined for low-density (50 pcf and under), precast, reinforced-concrete floor, roof, and wall units that will result in members of adequate load capacity, durability, appearance, and overall serviceability. Units covered in this guide should be protected from free entry of water. Current editions of applicable ASTM specifications are listed for the materials covered in the guide. Low-density concrete should have a minimum compressive strength of 300 psi, and average drying shrinkage should not exceed 0.20%. Low-density concrete units should be designed for allowable working stresses, service loads, and accepted straight line theory of design. Deviations from design requirements and treatment of regular concrete are discussed. (USBR)
W69-00583

CONCRETE WITH REINFORCED PLASTICS COATING,
Technical Univ, Prague, Czechoslovakia.
Vladimir Weiss.
Tech Dig, Vol 10, No 6, pp 369-374, June 1968. 6 p, 5 fig, 2 tab, 7 ref.

Descriptors: *Composite materials, *Laminates, *Sandwiching, Plastics, Reinforcing, *Reinforced concrete, Materials, Materials forming, Foreign design practices, *Coatings, Brittleness, Tensile strength, Cracking, Bending stress, Glass fibers, Ceramic materials, Concrete structures, Concrete.
Identifiers: Czechoslovakia, Polyesters, Glass reinforced plastics, *Plastic coatings, Composite beams.

The possibility of replacing steel reinforcement in concrete with reinforced plastics or glass fiber has kept researchers busy for many years. Work in Czechoslovakia has been concentrated on coating concrete and similar brittle materials with glass-fiber-reinforced polyester resin. The coating delays formulation of cracks and improves extensibility and bending strength of concrete and ceramic products. Tests were conducted to clarify the load-sharing mechanism and properties of coating and core materials affecting test results. The effect of the coating on extensibility, tensile strength, and bending strength of brittle materials has been so pronounced that prestressed concrete often may be replaced by ordinary reinforced concrete. A procedure is given for designing combinations of brittle core materials with resilient coatings. The method is applicable to combinations of concrete or ceramics with prestressed concrete, resin concrete, or sheet metal; asbestos-cement with fiber-reinforced plastics; and sandwich materials of lightweight concrete, hard-formed materials, and asbestos-cement materials. (USBR)
W69-00593

FIELD TECHNIQUES FOR SEALING LEAKY CONCRETE PIPELINES WITH AMMONIATED IRRIGATION WATERS, OPEN AND CLOSED CONDUIT SYSTEMS RESEARCH PROGRAM,
California Univ, Davis; Solano Irrigation District, Vacaville, Calif.
K. K. Tanji, L. D. Doneen, and J. V. Kubes.
Bur Reclam Lab Rep ChE-79, Chem Eng Br, May 1968. 54 p, 2 map, 11 tab, 20 photo, 7 ref.

Descriptors: *Concrete pipes, *Cracks, Chemistry, Water analysis, pH, Conduits, Pipelines, *Leakage, Water transportation, Seepage, Additives, Chemicals, *Sealing compounds, Maintenance, Operation and maintenance, *Lime, *Chemical precipitation, Irrigation O and M.
Identifiers: *Calcium carbonate, Irrigation water, *Anhydrous ammonia, Chemical reactions, *Chemical sealants, Solano Project, Calif.

A method is described for sealing narrow cracks in concrete pipelines. Anhydrous ammonia and other amendments added to water produce a hard calcium carbonate precipitate which deposits in cracks in the pipe and seals the leaks. Laboratory investigations were made on the chemistry of surface and ground waters suitable for lime precipitation. Selective precipitation of lime from ammoniated waters and its adherence to concrete pipelines are largely dependent upon the chemical composition and imposed treatments. Many irrigation waters are not suitable for precipitating lime unless treated with appropriate amendments. Theory and principles from the laboratory research were applied in field tests. Methods and techniques were developed for sealing leaky concrete pipelines. The field application and results obtained in some treatment operations with surface and well waters are presented. (USBR)
W69-00610

CRITERIA FOR CATHODIC PROTECTION OF STEEL IN CONCRETE,
American Pipe and Construction Co, South Gate, Calif.
D. A. Hausmann.
Preprint Pap No 74, Nat Ass Corros Eng, Cleveland, Ohio, 1968. 4 p, 5 fig, 7 ref.

Descriptors: *Cathodic protection, Corrosion, *Corrosion control, Concrete structures, Portland cement, Chlorides, Electrolysis, Steel, Electrochemistry, *Reinforced concrete, *Reinforcing steel, Electrodes, Electric potential, Design criteria, Electric currents, Polarization.
Identifiers: Corrosion tests, Corrosion resistance, Stray current corrosion, Corrosion currents.

Cathodic protection is a useful corrosion control technique, but indiscriminate use can be costly and damaging. Misapplication is possible with reinforced concrete structures if the passivating effect of portland cement is not recognized. Some reinforced concrete structures are cathodically protected, as if they were bare or coated steel structures, by using the buried steel pipeline criterion of applying current to maintain a minimum steel potential of -0.85 v to a copper sulfate electrode. Experimental results show that this criterion is not applicable to steel cast in concrete and will result in overportection. Steel corrosion can be prevented in concrete exposed to a high chloride environment if sufficient current is applied to shift the steel polarization potential to a minimum value of -0.50 v to a copper sulfate electrode. Steel corrosion can be arrested in chloride-contaminated concrete by shifting the polarization potential to a minimum value of -0.71 v to a copper sulfate electrode. The polarization potential should be shifted to a minimum of -0.40 v to a copper sulfate electrode to prevent damage by stray current electrolysis. (USBR)
W69-00611

ARCHITECTURAL CONCRETE,
Architectural Concrete Consultants Inc, Houston, Tex; Hellmuth, Obata and Kassabaum, St Louis, Mo.
James M. Shilstone, Gyo Obata, and Matthys P. Levy.
J Amer Concr Inst, No 7, Proc V 65, pp 513-534, July 1968. 22 p, 26 fig, 3 tab.

Descriptors: *Architecture, *Concrete, Concrete finishing, Coatings, Precast concrete, Building materials, Buildings, Shell structures, Forms (Concrete), Finishes, Concrete placing, Joints, Curing, Specifications, Reinforced concrete, Shrinkage, Costs, Aggregates, Creep, Structural engineering, Abrasive blasting, *Aesthetics, Construction, Planning.
Identifiers: Exposed aggregate concrete, Concrete construction, Concrete properties.

This series of papers is based on a symposium presented at the 1966 ACI Fall Meeting in New Orleans. The papers review considerations required for architectural concrete that must be structurally sound, aesthetically pleasing, and economical. Following a brief introduction, 4 authors discuss the architects' approach, structural implications, planning requirements, and construction. When an architect selects concrete as the aesthetically correct material, he must check the structural appropriateness. In addition to obvious design considerations, the structural designer must give special attention to detailing placement of joints, placement of reinforcement, and curing methods to obtain the desired effects. Advance detailed planning is important when using architectural concrete because lines that appear effective on drawings can be difficult and costly to achieve in construction. Building with architectural concrete requires detailed consideration of materials, forming techniques, concreting operations, and surface finishing. (USBR)
W69-00614

8G. Materials

POLYMER COATINGS PIGMENT DISPERSION,
PPG Industries, Pittsburgh, Pa.
V. Buttignol, and Howard L. Gerhart.
Ind Eng Chem, Vol 60, No 8, pp 68-79, Aug 1968. 12 p, 12 fig, 3 tab, 42 ref.

Descriptors: Reviews, *Paints, Coatings, Flocculation, Bibliographies, *Protective coatings, Painting, *Polymers, *Pigments, Vehicles, Physical chemistry, *Dispersion, Mixing, Adsorption, Light, Scattering, Solvents, Surface properties, Materials.
Identifiers: *Wetting, Separation, Double layer, Resins.

The technology of pigment dispersion in polymer paint manufacturing is reviewed. The dispersion process is complicated, incompletely understood, and in practice is regularly and consciously neglected as to its scientific delicacy. Our present imperfect understanding starts with uncertainty about the pigment surface structure and is complicated by the great variety of phenomena as the liquid polymer finds its place upon the solid particle. Absorption mechanisms and theories of dispersion are reviewed to improve understanding of the complex process. The 3 basic stages in the dispersion process are wetting, deagglomeration or physical separation of particles by force, and stabilization. The dispersion of pigment as it exists in the cured paint film is very important as a fourth stage but has been neglected. A suggestion is made that a more profitable approach would be to study the end result (dispersion in the cured film) and work backward to find the optimum conditions at the earlier stages. This approach was adopted by the Springdale Research Center and resulted in developing a paint utilizing a new light scattering concept with extraordinary efficiency. (USBR)
W69-00578

CONCRETE WITH REINFORCED PLASTICS COATING,
Technical Univ, Prague, Czechoslovakia.
For primary bibliographic entry see Field 08F.
For abstract, see .

W69-00593

8H. Rapid Excavation

GEOPHYSICAL LOGGING AND HYDRAULIC TESTING, PAHUTE MESA, NEVADA TEST SITE,
U S Geological Survey, Las Vegas, Nevada.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00434

CANAL CONSTRUCTION USING ROW CHARGES IN THE EXPLOSIVE EXCAVATION AT ALLARECHENSK MINE,
Soiuzvzryvprom, USSR.
F. A. Avdeev.
Vzryvnoe delo, Sb 61/18, pp 161-175, Moscow, 1966. Transl from Russ, Bur Reclam Transl 773, June 1968. 37 p, 11 fig, 7 tab, append, 2 ref.

Descriptors: *Canals, Explosions, *Explosives, *Excavation, Foreign projects, Charges (Explosives), Soil mechanics, Methodology, *Cratering, Soil liquefaction, Soil structure, Drainage, Moraines, Sand boils, Soil physical properties, Sands, Soil moisture, Pore water pressures.
Identifiers: USSR, Depth, Allarechensk Canal, USSR, Depth of burst, *Explosive excavation, Unstable ground, Spacing, Spaced charges.

A special bureau of explosive experts in the USSR used row-charge explosive excavation to build the Allarechensk drainage canal to drain a mining area in Kirgistan. Design data were: length 4.7 km, width at bottom 5.5 m, bottom slope 0.0015, side slopes 2.5:1, depth 3 to 10 m, and average discharge 27 to 34 cu m/sec. Most of the canal runs through morainic stable soils, but unstable liquefying soils were encountered in one reach. Conclusions were that: (1) the method is feasible for hydraulic structures located away from industrial areas, saving construction time and requiring less equipment; (2) in morainic soils with 30 to 35% boulders, the method excavates a design profile with stable side slopes; (3) in yielding soils, the method enables reductions in labor and time, but more explosives must be used to compensate for inability to place charges at optimum depth; (4) the method can be used in unstable liquefying soils by double explosion, the first to destroy the soil structure and the second to excavate the structure after draining; (5) using war surplus explosives is feasible; and (6) further investigations of explosions for liquefying soils are needed. (USBR)
W69-00613

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

A COMPILATION OF WATER RESOURCES RESEARCH AND GRADUATE TRAINING ACTIVITIES AT NEW MEXICO STATE UNIVERSITY,
New Mexico State Univ., University Park.
John W. Hernandez.
New Mexico State Univ, WRRI Publications No 1, 1966. 72 p. OWRR Project A-999-NMex.

Descriptors: Water resources, *Water resources development, Hydrology, Ecology, Research and development, Economics, Hydraulics, Agriculture, Fluid mechanics, Irrigation, Limnology, Water treatment, Water quality, Education.
Identifiers: *Research project notices.

This publication is a summary of active research studies and supported graduate training programs in the water-resource field at New Mexico State University as of July 1, 1966. Training programs receiving outside grants are included in the text as they provide a significant source of funding for graduate students. The current research projects included in the compilation have been classified into subject matter groups shown in the Table of Contents. An index listing authors, research topics, and funding agencies is included. This compilation reflects the magnitude, interest and diversity of water resources research being conducted throughout the University. It will be noted that a number of the studies listed are not funded by the University nor by any outside agency. In general, projects of this nature are in a preliminary development stage or are unsupported student thesis topics. Funded projects are administered through one or more of the following organizations: (1) the Water Resources Research Institute, (2) the Agricultural Experiment Station, (3) the Engineering Experiment Station, and (4) the Research Center.
W69-00648

9C. Research Facilities

BRIDGER HYDROMETEOROLOGICAL RESEARCH AREA AND FACILITIES,
Montana State Univ., Bozeman, Water Resour. Res. Center.
R. J. Rickabaugh.
Rep 4 of Proj 779 (See W69-00452 and W69-00454), Jan 1967. 26 p, 47 fig, 1 tab. OWRR Proj B-006-Mont.

Descriptors: *Research facilities, *On-site laboratories, On-site data collections, Data collections, Field data, Meteorology, Montana, *Meteorological data, Weather data, Communication, Electronic equipment, Instrumentation, Evaluation, Radio communication systems, Telephones.

The Bridger Hydrometeorological research area and facilities 20 mi north of Bozeman, Montana are described. Numerous photographs, illustrations and maps are used to present the research facility and site locations.
W69-00453

9D. Grants, Contracts, AND Research Act Allotments

INVENTORY OF ACTIVE WATER RESOURCES RESEARCH PROJECTS IN NORTH CAROLINA,
North Carolina Univ., Chapel Hill, Water Resour. Res. Inst.
David H. Howells.
Rep 4, Apr 1967. 80 p. OWRR Proj A-999-NC.

Descriptors: Census, *Water resources, *Research and development, *North Carolina, Water resources development.

This inventory of water resources research projects in North Carolina is one of three basic reports prepared by the Water Resources Research Institute to guide the development of its research program. Earlier reports included 'Water Resources Problems and Research Needs of North Carolina' and 'Water Resources Research Interests in the Senior Colleges and Universities of North Carolina.' The report lists all known research projects in North Carolina, including private industry and the State and Federal Agencies. It will be revised annually.
W69-00458

CURRENT WATER-RELATED STUDIES IN THE STATE OF MAINE,
Maine Univ., Orono, Water Resources Center.
Warren Viessman, Jr.
Water Resour Center Publ 3, Univ Maine, Apr 1968. 68 p. OWRR Project A-999-Me.

Descriptors: *Bibliographies, *Maine, *Abstracts, *Water resources, Ecology, Biology, Erosion; Soil erosion, Geochemistry, Hydrology, Irrigation, Marshes, Recreation, Soils, Water treatment, Water quality, Waste treatment, Meteorology, Weather, Climatology.

This document lists 93 water-related investigations underway in Maine. Information gives name of project, principal investigator, source of funds, name and address of agency, and abstract of work.
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VOLUME 2, NUMBER 3
FEBRUARY 1, 1969

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NEW SERIES

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is $22.00 (domestic), $27.50 (foreign); single copy price is $3.00.

SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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VOLUME 2, NUMBER 3
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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States--now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

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To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions AND Suspensions

SOLUBILITY EQUILIBRIA INVOLVING METAL OXIDES AND CORRESPONDING AQUEOUS METAL PERCHLORATES,
North Carolina Univ., Chapel Hill, Chem Dept.
For primary bibliographic entry see Field 02K.
For abstract, see .
W69-00998

02. WATER CYCLE

2A. General

HYDROLOGICAL DATA AND PEAK DISCHARGE DETERMINATION OF SMALL HAWAIIAN WATERSHEDS: ISLAND OF OAHU,
Hawaii Univ., Honolulu.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00709

ANALOG COMPUTER FOR HYDROLOGIC RESEARCH,
Nevada Univ., Reno.
D. F. Schulke, P. A. Domenico, and G. B. Maxey.

Desert Res Inst, Proj Rep 7, Nov 1966. 30 p, 18 fig, 1 tab. OWRR Project B-005-Nev, A-003-Nev.

Descriptors: *Analog models, *Model studies, Synthetic hydrology, *Mathematical studies, *Darcys Law, Fluid flow, *Theoretical analysis, Groundwater, Surface water, Analog computer, Flow.
Identifiers: Hydrologic phenomena, Electrical phenomena, Ohms Law.

When it is possible to find an analogy between one phenomenon and another that is easier to observe, information about the first can be obtained by observing the second. Such an analogy exists between hydrologic phenomena and electrical phenomena. For solution of hydrologic problems two types of analog computers are used: (1) direct or unique analog is used more often for solving ground water problems. It applies the time variant or transient flow of ground water as simulated by the varying flow of current in electricity. This and other hydrologic parameters are simulated by utilization of the analogy between Darcy's Law for flow of fluids and Ohm's Law for flow of electricity; (2) general analog is used more often for surface-water problems and differs from the unique analog in that it is a mathematical rather than a physical analog. It consists of an assemblage of computing elements each capable of some mathematical operation. The analogy between indirect analog and physical system is the equation being solved. Examples of both types of analogs are given. Many surface and ground water problems are thus capable of being analyzed which otherwise would not be attempted due to their complexity and the time normally required for their solution.
W69-00739

THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL,
Oklahoma State University, Norman, Agr. Eng. Dept.
Charles E. Rice.
July 1968, 9 p. OWRR Project A-006-Okla.

Descriptors: *Overland flow, *Rainfall-runoff relationships, *Mannings equation, *Darcy-Weisbach equation, Uniform flow, Turbulent flow, Laminar flow, Discharge coefficients, Roughness (Hydraulic), Flume.
Identifiers: *Synthetic grass, Effective bottom.

Research methods are used for developing prediction equations and measuring actual water surface profiles for unsteady spatially varied sheet flow over various surfaces. Procedures for routing various rainfall rates through the sheet flow phase into channel flow are presented. Studies on synthetic grass material show that 2 regimes of flow occur, one when flow depth is less than the height of the grass (laminar flow) and the other when flow depth is greater than grass height (turbulent flow). Because the experimental grass occupied a considerable part of flow depth the physical bottom was assumed as not being representative of the effective bottom. For turbulent flow an effective bottom was determined as the intercept of water surface plotted against discharge to the 0.6 power. The Manning coefficient for turbulent flow range increased a little with discharge and its value (average of about 0.032) indicates that synthetic grass has a high retardance to water flow. (Lang-USGS)
W69-00915

VARIABILITY IN RAINFALL PRODUCING RUNOFF FROM A SEMIARID RANGELAND WATERSHED, ALAMOGORDO CREEK, NEW MEXICO,
Southwest Watershed Research Center, Tucson, Arizona.
J. C. Drissel, and H. B. Osborn.
J Hydrol (Amsterdam), Vol 6, pp 194-201, 1968. 8 p, 6 fig, 4 ref.

Descriptors: Variability, *Runoff, *Rainfall disposition, Watersheds (Basins), Hyetographs, Wet seasons, Hypsometric analysis, Convection, Fronts (Atmospheric), Semiarid climates, Orography, Thunderstorms, *Precipitation intensity, Precipitation gages, *Demonstration watersheds, *Rainfall-runoff relationships, Meteorological data.
Identifiers: Alamogordo Creek (New Mexico).

The study was conducted on the 67 square mile Alamogordo Creek watershed in New Mexico. Rain gage density was approximately one gage for every two square miles. Most winter precipitation occurred as low-intensity rain or snow along slow-moving cold fronts. Summer rains yielded 80% of the annual rainfall and were produced generally by short-duration, high-intensity thunderstorms. Mean annual precipitation for the period (1956-1965) was 11.18 inches, with a standard deviation of 4.92 and median of 10.96 inches. All runoff was produced by summer storms (May through October). Mean annual runoff was 0.37 inches (approximately 20 acre-feet per square mile or 1330 acre-feet), which was 3.3% of the mean annual precipitation. Runoff varied more than rainfall. In 1964 total runoff was only 0.03 inches (107 acre-feet) while in 1960, 2.34 inches (8360 acre-feet) were recorded. About 60% of the total runoff from 1956-1965 was produced in 1960. 93% of the total runoff for the 10 year period occurred during June, July and August. (Blecker-Ariz)
W69-01009

HYDROGEOLOGY OF DESERT BASINS,
Desert Research Institute, Reno, Nevada.
George B. Maxey.
Groundwater, Vol 6, No 5, pp 10-22, Sept-Oct 1968.

Descriptors: *Hydrogeology, *Great Basin, *Nevada, Discharge (Water), Base flow, Geologic investigations, Hydrologic aspects, *Hydrologic budget, Water chemistry, Groundwater basins, Reservoirs, Carbonate rocks, Water resources development, Recharge, *Watersheds (Basins), Drainage patterns (Geologic).
Identifiers: Geologic aspects, *Hydrologic systems, *Regional flow systems, Inter-basin flow, Flow systems.

The hydrologic system of the Great Basin in Nevada was utilized in order to describe salient characteristics of arid basins, to describe some methods used to delineate and defvine hydrologic systems and to demonstrate the importance of ground water reservoirs. Ground water systems of the Great Basin consisted of (1) local flow systems with small drainage areas, short flow paths, rare interbasin flow, large fluctuation of springs discharge, low water temperature and low concentration of Na, K, Cl and SO sub 4 and (2) regional flow systems with large drainage areas, long flow paths, common interbasin flow, large discharge of springs and higher concentrations of K, Na, Cl and SO sub 4. Hydrologic approaches included hydrologic budget, water potential and water chemistry studies. Integration of hydrologic, geologic and chemical methods allowed approximate portrayal of many systems, both local and regional. (Affleck-Ariz)
W69-01013

SOME REMARKS ON NON-DARCY FLOW,
Negev Institute for Arid Zone Research, Beersheba, Israel.
Richard Kraft, and Daniel Yaakobi.
J of Hydrology (Amsterdam), Vol 4, No 2, pp 171-181, June 1966. 11 p, 6 fig.

Descriptors: *Darcy's law, *Hydraulic gradient, Velocity, Permeability, Porosity, *Clays, Discharge measurement, *Theoretical analysis, *Equations, Model studies.

Until recent times, Darcy's law was believed to be valid over the complete range of hydraulic gradients. Instead of discharge velocity being directly proportional to the hydraulic gradient, a nonlinear relationship was found in the low hydraulic existence of non-Darcy behavior revealed that its existence is not firmly supported by experiment. The paper discussed critically four non-Darcy experiments and made suggestions on how they might be improved from an experimental and theoretical viewpoint. There was little agreement as to the theoretical explanation for non-Darcy phenomena. A brief theoretical derivation of Darcy's law was given. A new system for determining permeability was described. Non-Darcy flow was discussed briefly from a theoretical perspective. From theoretical considerations, it was suggested that when future permeability tests are made they cover a wide range of different porosities and clay types with varying Chapman-Gouy potentials. (Blecker-Ariz)
W69-01027

WATER RESOURCES OF EAST-CENTRAL MISSISSIPPI, CLARKE, JASPER, LAUDERDALE, NEWTON, SCOTT, AND SMITH COUNTIES--A PROGRESS REPORT,
U S Geological Survey Jackson Miss Water Resources Div.
E. H. Boswell.
U S Geol Surv open-file rep, 14 p, Aug 1968. 4 fig, 3 tab.

Descriptors: *Water resources, *Groundwater, *Surface waters, Mississippi, Aquifers, Water quality, Water yield, Streamflow, Low flow, Water storage, Water utilization, Reservoirs.
Identifiers: East Central Mississippi.

Data obtained in an investigation of the water-resources potential for industrial development in east-central Mississippi are summarized. The area is deficient in perennial streamflow, and it is drained by no large streams. The headwater tributaries of the Pascagoula, Pearl, and Tombigbee Rivers drain the northern part; the Chickasawhay, Leaf, and Strong Rivers drain the southern part of the area. Base flows in the larger streams are low but well sustained; the smaller streams are intermittent. Surface-water flow from the area at low flow may be as little as 100 mgd. Surface supplies must be enhanced by surface storage. One large reservoir is under construction and others are planned. Artesian aquifers underlie the area, may yield large quantities of water, and are largely unused. The two most important aquifers are the Lower Wilcox, under the NE 85% of the area, and the Sparta sand,

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under the SW 80%. Groundwater is soft to moderately hard Na-bicarbonate type at shallow depths, and soft, chloride type with higher total solids deeper. Pollution is a problem only in two creeks in Lauderdale and northern Clarke Counties. (Knapp-USGS)
W69-01031

THEORETICAL CONCEPT OF OXYGEN TRANSFER IN GAS BUBBLE AERATION SYSTEM.
Rhode Island Univ, Kingston.
Calvin P. C. Poon.
Water Resour Center, Completion Rep, July 1968. 11 p, 12 ref. OWRR Project A-015-RI.

Descriptors: *Diffusion, *Aeration, Temperature, Pressure, Flow rates, Turbulent flow, Mathematical models, Oxygen requirements, Gasses, Mass transfer, Bubbles.

A mathematical model was developed for diffused aeration relating the oxygen diffusion coefficient to its controlling factors such as temperature, pressure, bubble size, and rate of air flow. By considering the diffused aeration as a 2-step process, namely molecular diffusion and turbulent diffusion, the model was developed using the principle of statistics of molecular motion as well as a hydraulically defined surface renewal rate. The mathematical model should help engineers and operators in aeration practice to understand and to control better the process.
W69-01129

APPLICATION OF ELECTRONIC ANALOG COMPUTER TO SOLUTION OF HYDROLOGIC AND RIVER-BASIN-PLANNING PROBLEMS: UTAH SIMULATION MODEL II,
Utah State Univ, Logan.
J. Paul Riley, Duane G. Dhadwick, and Jay M. Bagley.
Rep REWG 32-1, Water Res Lab, Oct 1966. 129 p, 41 fig, 9 tab, 52 ref, 2 append. OWRR Project B-005-UTAH.

Descriptors: Surface runoff, Groundwater, *Model studies, *Analog computers, Infiltration, Rainfall, Runoff, Snowmelt, Evapotranspiration, Deep percolation, Precipitation (Atmospheric), Temperature, Hydrologic data, Insulation, Water yield, Water yield improvement, *Hydrology, Research and development, *Water resource development, Soil moisture.

As demand on water supplies increase, there is an accompanying increase in the need to assess consequences resulting from changes at specific locations. At Utah State University this problem is being approached by electronic analog simulation of the hydrologic system. Modeling concepts are based upon development of basic relationships which describe the various hydrologic processes. Within a system, these relationships are linked by the continuity-of-mass principle which requires a hydrologic balance at all points. Once established, the model is applied to any particular geographic unit by determining the appropriate constants of the hydrologic equations. The complexity of a hydrologic model depends largely upon the magnitude of time and spatial increments utilized in the model. In this study the mathematical development was based on the concept of relatively small increments of space and large time increments. The model is therefore applicable to in-basin problems involving a time increment of, for example, 1 month. The Circle Valley subbasin of the Sevier River system was simulated to verify the model. Close agreement between computed and observed outflows was achieved on a monthly and total annual basis.
W69-01145

AN EXPERIMENTAL RAINFALL-RUNOFF FACILITY,
Colorado State Univ, Fort Collins.
W. T. Dickinson, M. E. Holland, and G. L. Smith.
Colorado State Univ Hydrol Pap 25, Sept 1967. 81 p, 13 fig, 4 tab, 255 ref. OWRR Project B-005-COLO.

Descriptors: Artificial storms, *Demonstration watersheds, *Model studies, Overland flow, *Small watersheds, Erosion, Water pollution, *Test facilities, Watersheds, Runoff, Rainfall, Models, Research and development, Bibliographies.
Identifiers: *Rainfall-runoff relation, Research facilities, Hydrologic models.

Part I. An experimental facility is described for investigation of rainfall-runoff relationship. The facility is large enough to respond as a prototype watershed, but small enough to permit controlled variation of watershed characteristics and artificial application of a rainfall. Criteria for the facility are related to: (1) control of reasonably uniform rainfall, (2) measurement of variables, with attention to variations in time and space, and (3) variation of watershed parameters. The experimental facility has potential application in studies of rainfall runoff response, erosion, and travel of pollutants on watersheds. Part II. Design and construction of rainfall-runoff experimental facility is described. Three phases are discussed: (1) site selections, (2) selection of basic geometry of facility, and (3) design and construction techniques of site preparation, methods of precipitation and discharge measurement with automatic digital recording of data, soil surface treatment, and proposed precipitation towers. Part III. A review and appraisal of status of mathematical models of hydrologic watershed response is followed by an annotated bibliography of 226 references relating studies of watershed response.
W69-01162

THE EFFECTS OF GEOGRAPHICAL AND CLIMATIC SETTING ON THE ECONOMIC ADVANTAGES OF ALTERNATIVE FLOOD CONTROL MEASURES,
Kentucky Univ Water Resources Inst, Lexington.
Clyde R. Dempsey.
Kentucky Univ Water Resources Inst Res Rep No 10, 166 p, 1968. 26 fig, 45 tab, 32 ref, 5 append. OWRR Project A-001-Ky.

Descriptors: *Flood control, *Climatology, *Watersheds (Basins), Computer programs, Urbanization.
Identifiers: *Pond Creek, Kentucky, Drainage area.

A joint research project was undertaken to evaluate the effects of climatic setting and geographical location on relationships of flood peaks and flow regime in a given watershed. A previously developed Stanford Watershed Model was applied to a drainage area near Louisville, to illustrate the optimum flood control program in a growing urban area in a humid climate. This general study was done to alleviate flood damages through the construction of structural measures for flood control, since the work already done had not fully achieved its intended purpose. In this joint research project, 2 computer programs were developed to facilitate mathematical steps in the design process to be applied to a particular flood plain. The hydrologic input data required for the computer program involves flood peaks and flood hydrographs as functions of tributary or urbanization, channelization, and drainage area. (Llaverias-USGS)
W69-01172

REVIEW AND ANALYSIS OF RAINFALL AND RUNOFF DATA FOR SELECTED WATERSHEDS IN MINNESOTA,
Minn Univ, Anthony Falls Hydraul Lab, Minneapolis.
C. Edward Bowers, and Arthur F. Pabst.
Minn Univ St Anthony Falls Hydraul Lab Proj Rep No 97, 32 p, June 1968. 55 fig, 8 photo, 9 tab, 10 ref, 5 append. OWRR Project A-013-Minn.

Descriptors: *Rainfall-runoff relationships, *Depth-area-duration analysis, *Discharge (Water), Mathematical models, Flood routing, Minnesota.

Available rainfall and runoff data for selected watersheds in Minnesota were analyzed to assist in the evaluation of peak rates of runoff for design purposes; 6 watersheds were selected for study. Rainfall and runoff data were analyzed for 51 flood events in 5 of 6 watersheds. A computer program prepared by the U S Army Corps of Engineers Hydrologic Engineering Center was used to optimize 9 variables associated with the watersheds, develop characteristic unit hydrographs, and evaluate loss rates for the watershed in terms of the mathematical model represented by the optimization program. Data on annual maximum floods as well as maximum summer floods were plotted on log-probability paper and theoretical flood-frequency curves determined by the log-Pearson Type III distribution. Approximately 200 figures relating to the rainfall-runoff data have been included in the appendices. (Knapp-USGS)
W69-01187

2B. Precipitation

AN INVESTIGATION OF SOME PRECIPITATION PATTERNS OF CALIFORNIA AND ADJACENT REGIONS,
California Univ., Los Angeles.
Charles B. Pyke.
Water Res Center Rept, Apr 1966. 111 p, 18 fig, 13 tab, 45 ref, append. OWRR Project A-016-Cal.

Descriptors: *Atmospheric precipitation, *Rainfall, Meteorology, *Investigations, Climatology, Correlation techniques, Seasons, Seasonal, Precipitation (Atmospheric), Correlation analysis, California.

A detailed study of geographical and seasonal distribution of precipitation patterns over the far western U S reveals interesting and complicated features and aids in understanding the large-scale synoptic meteorological processes responsible for production of precipitation. Climatic fluctuations and short-term climatic changes taking place in the precipitation patterns over the region are also studied, and an attempt is made to relate changes in precipitation patterns to changes in atmospheric circulation patterns. Monthly totals of precipitation for 57 selected stations within the region of investigation were used as the data for this project; and computations of seasonal totals and averages over 5- to 30-yr periods were made for all of these data. Definite climatic fluctuations of relatively short duration (10-30 yr) are observable from the computations. In addition a slight overall downward trend in the annual total of precipitation, particularly since 1915, is visible in southern California and along the coast of central California.
W69-00736

LA TEMPORADA DE CICLONES DE 1967 Y SU CONTRIBUCION A LA PRECIPITACION ANNUAL EN MEXICO (The Hurricane Season of 1967 and the Contribution to the Annual Rainfall in Mexico),
Mexico, Del Instituto de Geografía UNAM.
O. E. Jauregui.
Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 169-176, 1968. 8 p, 4 tab, 2 fig, 3 photo, 5 ref. (Transl. from Spanish by Rita Llaverias).

Descriptors: *Cyclones, *Precipitation excess, *Flood damage, *Mexico, Wind velocity, Soil moisture, Hurricanes, Arid lands, Gulf of Mexico.
Identifiers: *Cyclone, *Beulah, Satellite.

The contribution of the 1967 tropical cyclone season to the annual precipitation in Mexico is reported. Beulah, with winds reaching 190 km/hr, caused damage in Mexico equal to that done by Betsy in Louisiana (Sept 1965). Damage caused by Beulah from Martinique to the Tamaulipas border was estimated at 1,000 million dollars. Formed in the Lesser Antilles, Beulah first battered Martinique. Entering the Caribbean south of Puerto Rico, it touched the Dominican Republic, passed over Haiti, and skirted Jamaica at which point winds grew in intensity up to 190 km/hr. Then

cyclone Beulah hit Mexico. Heavy rains accompanying the hurricane caused numerous floods through half of the country. Nonetheless, these torrential rains made 1967 a good year for arid and semi-arid lands in Lower California and around the Lower Bravo River (Rio Grande). Such phenomena transport much humidity and supply the convective processes necessary to convert moisture into rainfall. A table and a map show numerical values for the contribution of precipitation in selected areas. Other tabular data indicate that rain from tropical cyclones contributes from 13 to 41% of total precipitation along the Atlantic Coast and Gulf of Mexico. Biological and socio-economic aspects involved in modifying the weather are also briefly discussed. Photos of the tropical cyclone made from a satellite show size, shape, and location at different times. (Llaverias-USGS)
W69-00942

WATER RESOURCE OBSERVATORY CLIMATOLOGICAL DATA WATER YEAR 1966 AND PRIOR.
Wyoming Univ., Laramie.

Water Resour Res Inst, Water Resour Series 8, Dec 1967. 323 p, 297 tab.

Descriptors: Data processing, *Climatic data, Climatology, Weather data, *Meteorological data.

Data that have been reduced from hygrothermograph charts and nonrecording precipitation gages are presented in tabular form. The mean, maximum, and minimum temperatures are also shown graphically. The data are transferred to punch cards for computation and tabulating by the University of Wyoming's digital computer. The card format and computer program are presented.
W69-00978

RADAR ESTIMATION OF RAINFALL,
New Zealand Meteorological Service, Wellington.
A. P. Ryan.
J Hydrol (New Zealand), Vol 5, No 2, pp 100-110, 1966. 11 p, 3 fig.

Descriptors: *Rainfall, *Radar, *Weather patterns, *Raingages, Measurement, Equations, *Raindrops, Instrumentation, Remote sensing, Calibrations, Meteorology, Wavelengths.
Identifiers: *Reflectivity.

Preliminary results of using radar to estimate rainfall at Ohakea, New Zealand were given. The radar was calibrated and stability was found satisfactory for short and long periods. Eight recording raingauges were set up in an area of 24 square miles. The area was 14 miles from the radar, and a good line-of-sight visibility was present. All three trials were done on occasions of patchy, mainly light rain and individual rain areas were small. Quantitative radar rainfall measurements were feasible with an accuracy at least as good as that of conventional raingauge networks in most areas. Even in the case where the radar estimate is less accurate than that obtained from the existing raingauge network in arid areas, it has an advantage in that it becomes available as the rain falls and includes valuable data on size and movement of rain areas. (Blecker-Ariz)
W69-01029

ON THE COMPARISON OF PRECIPITATION GAUGES,
India Meteorological Office, Poona.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01030

TIME DISTRIBUTION OF RAINFALL IN HEAVY STORMS,
Illinois State Water Survey, Urbana.
F. A. Huff.
Water Resources Res, Vol 3, No 4, pp 1007-1019, 1967. 13 p, 8 fig, 8 tab, 8 ref.

Descriptors: *Rainfall, *Rainfall disposition, *Storms, Hyetographs, Histograms, Synoptic analysis, Statistical models.
Identifiers: Rainfall time distribution.

Time distribution relations have been developed for heavy storms on areas ranging up to 400 square miles and presented in probability terms to provide quantitative information on interstorm variability and to provide average and extreme relations for various applications of the findings. It was found that the relations could be represented best by relating per cent of storm rainfall to per cent of total storm time and grouping the data according to the quartile in which rainfall was heaviest. The individual effects of mean rainfall, storm duration, and other storm factors were small and erratic in behavior when the foregoing analytical technique was used. Basin area had a small but consistent effect upon the time distribution. The derived relations are applicable to the Midwest and other areas of similar climate and topography. They can be used in conjunction with published information on spatial distributions and other storm parameters to construct storm models for hydrologic applications. (Author)
W69-01045

OPTIMUM DENSITY OF RAINFALL NETWORKS,
Massachusetts Institute of Technology, Cambridge. Dept of Civil Engineering.
For primary bibliographic entry see Field 07A.
For abstract, see .
W69-01046

PSYCHROMETRIC TABLES FOR WYOMING,
Wyoming Univ, Laramie.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-01159

PATTERN OF PRECIPITATION DISPERSION AS AFFECTED BY DIFFERENT VEGETATIVE COVERS IN MAINE,
Maine Univ, Sch of Forest Resources, Orono.
Charles E. Schomaker.
Includes papers from Maine Farm Res Quart, Vol 15, No 2, July 1967, and from Forest Sci, Vol 14, No 1, pp 31-38, Mar 1968. Water Resources Res Proj Completion Rep, 18 p, July 1968. 7 fig, 2 tab, 17 ref. OWRR Project A-005-ME.

Descriptors: *Interception, *Water loss, *Birch trees, *Coniferous trees, Maine, Stemflow, Snow, Rain, Solar radiation.
Identifiers: *Precipitation dispersion.

The interception of precipitation by conifer and hardwood stands was measured and compared. The conifer stand has a basal area of 140 sq ft per acre and a crown coverage of 75-80%. The overstory trees are 88% spruce with an average diameter of 9 in. The remaining 12% of the overstory is white pine with diameters of 16 in. or more. The hardwood stand is 68% white birch, 22% red maple, and some beech and hemlock. Diameters average 5-6 in. Basal area is 100 sq ft per acre, and crown coverage is 80-85%. Precipitation was 35.65 in. from 79 storms. Snow fell in 21 of the storms. The spruce intercepted 35.5% and the birch, 17.9%, and in both stands, winter interception was higher. The birch intercepted about the same percentage in winter and summer, but the spruce intercepted significantly more in winter. Precipitation and interception data are tabulated. (Knapp-USGS)
W69-01173

2C. Snow, Ice, AND Frost

ATMOSPHERIC PROCESSES INVOLVED IN PRECIPITATION,
Alaska Univ., College.
Takeshi Ohtake.
Inst of Water Resour Rept 1968. 14 p, 16 fig, 3 tab, 8 ref. OWRR Project A-001-Alas.

Descriptors: *Ice, *Water vapor, Ice-water interfaces, *Fog, *Alaska, Cryology, Crystal growth, Air pollution, Air temperature, Moisture uptake, Atmospheric physics, Precipitation (Atmospheric), Drops (Fluid), Arctic.
Identifiers: Ice fog, Ice crystals.

This study began in the fall of 1964 in the Fairbanks area of Alaska. It involves an inquiry into sources and role of water vapor in ice fog, investigation of the relative concentrations of ice-fog particles, ice nuclei and condensation nuclei, and examination of the characteristics of nuclei and crystals by electron microscopy. With the electron microscope it was found that most nuclei of ice crystals which developed from sublimation of water vapor were located at the center of the ice crystals. In contrast, ice-fog particles result from freezing of super-cooled water droplets which form by condensation of water vapor from man-made sources of air pollution such as exhaust gases, open water surfaces on cooling pond, etc. The nuclei in these particles are not located in the center. Dense ice fog covering small areas originated from open water where the condensation nuclei concentration was much lower than in the downtown area, while thin but widespread ice fog was observed in the downtown area and along the highway. Dense ice fog was associated with large sources of moisture regardless of whether or not nuclei were abundant. The role of ice-forming nuclei and a preliminary consideration of synoptic conditions which cause ice fog is also discussed.
W69-00712

PREDICTION OF BEGINNING AND DURATION OF ICE COVER,
Colorado State Univ., Fort Collins.
John C. Ward.
Sanit Eng Pap No 2, Sept 1966. 34 p, 6 fig, 7 tab, 14 ref. OWRR Project A-003-Colo.

Descriptors: Surface waters, Temperature, *Oxygen demand, Thermal pollution, Sanitary engineering, Navigation, Fish, Water cooling, *Ice.
Identifiers: *Ice cover, Stream reaeration.

Ice cover is related to the capacity of streams to assimilate wastes because it cuts off air contact, and winter conditions may, in certain circumstances, produce greater oxygen deficits than summer conditions, in spite of the slower rates of deoxygenation and the higher oxygen saturation values of cold waters. The annual variation of stream water temperature can be well represented by a sine curve for most streams. However, streams in cold regions may be frozen over for as much as six months per year. In order to represent the annual variation of stream water temperature for these streams, a modification of the sine curve is necessary. The validity of the modified curve for streams that are frozen over for a portion of a year is indicated in that the duration and beginning date of ice cover is reasonably well predicted, and the stream water temperatures for the rest of the year are also predicted with a fair amount of accuracy. The effects of thermal pollution on the sine curve are reviewed, and the possible effect on ice cover is indicated. The possible application of the sine curve to lakes and reservoirs is illustrated. (Author)
W69-00715

WATER TEMPERATURES IN A SHALLOW LAKE DURING ICE FORMATION, GROWTH, AND DECAY,
U. S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.
Michael A. Bilello.
Water Resources Res, Vol 4, No 4, pp 749-760, Aug 1968. 20 p, 13 fig, 21 ref.

Descriptors: *Iced lakes, *Ice, *Ice-water interfaces, *Water temperatures, Limnology, Melting, Thawing, Melt water, Michigan, Heat budget.

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Identifiers: Seneca Lake, Ice formation, Shallow lake, Iceathaw periods, Ice decay.

Water temperature variations were measured continually and automatically recorded at Seneca Lake, near Houghton, Michigan, during conditions of ice formation, growth, and decay. A minimum of 0.2 deg C was recorded from just below the surface to the bottom of the lake before complete freeze-over occurred. The water temperature near the bottom of the lake increased from 0.3 to 3.0 deg C. A quantitative analysis of this heat gain attempts to show that most of the heat resulted from energy stored during the summer in the underlying soils. During the April ice-thaw period, the temperature throughout the main mass of water decreased substantially. Since the lake until this time was in a state of quasi-stable thermal stratification, it was assumed that this cooling resulted from the mixing of meltwater flowing into the lake from the surrounding snow. The sudden decrease in water temperatures coinciding with above-freezing air temperatures may be due to these physical processes: (1) near-freezing water released at the underside of the ice sheet as the ice melts; (2) ponding of melt water on the surface of the lake; (3) gravity flow of snow melt water (less than 4 deg C) from around the lake. (Llaverias-USGS)
W69-00930

WATER COOLING AND ICE THICKENING ON DINGMAN CREEK, NEAR LONDON, ONTARIO,
Alberta Univ, Edmonton, Canada.
Edward S. Spence.
Ontario Geogr, No 2, pp 49-66, 1968. 3 fig, 2 tab, 14 ref.

Descriptors: *Freezing, *Streams, *Water temperature, Correlation analysis, Air temperature, Humidity, Solar radiation, Streamflow, Wind velocity, Regression analysis.
Identifiers: Ontario.

The freezing processes of 2 small streams, near London, Ontario were studied by collecting a complete hourly record of air temperature and relative humidity from Nov 11, 1966 to Feb 28, 1967 partial records of sunshine and wind, daily water temperature data from 12 thermocouples at 1 ft intervals in a pond on one of the creeks, and daily water temperature taken in a turbulent stretch of the stream. Ice thicknesses were measured and daily mean ice thickness was calculated. Multiple correlation and regression techniques were used to relate water temperature, the dependent variable, to air temperature, humidity, sunshine, wind, and discharge. Ice thickness growth may be related to the variables by 2 equations with predictive potential, but data must be collected for several more seasons before they can be accurately evaluated. (Knapp-USGS)
W69-01167

2D. Evaporation and Transpiration

WATER LEVEL FLUCTUATION IN EVAPOTRANSPIROMETERS,
U. S. Geological Survey, Phoenix, Arizona, Water Resources Division.
T. E. A. Van Hylckama.
Water Resources Res, Vol 4, No 4, pp 761-768, Aug 1968. 5 fig, 24 ref.

Descriptors: *Water level fluctuations, *Evapotranspiration, *Instrumentation, Water balance, Arizona, Water levels, Groundwater, Soil moisture.
Identifiers: *Evapotranspirometer tanks, *Saltcedar.

To measure the water use by saltcedar, and to compare the quantities measured with those computed by various empirical and physical methods based on meteorological phenomena, 11 plastic-lined evapotranspirometer tanks were constructed near Buckeye, Arizona. Artificially maintained groundwater levels show distinct diurnal fluctuations in these instruments. On bare tanks or on vegetated tanks that are not transpiring, this fluctuation is highly correlated with diurnal and semidiurnal atmospheric fluctuations. Possible reasons for such response are discussed: (1) There might be air bubbles in the saturated zone; (2) It might be caused by the flexible plastic lining of the tank. Barometric efficiency is about 40%. On vegetated tanks that are transpiring, the water level and barometric curves are out of phase, but if the water levels are corrected for atmospheric pressure fluctuations, a curve appears that represents the hourly rate of water use. The graphs presented show how diurnal atmospheric pressure effects can be masked and yet can have influenced the water level in transpiration wells. The results may be important in the interpretation of transpiration well data. (Llaverias-USGS)
W69-00924

ESTIMATING EVAPOTRANSPIRATION IN A HUMID REGION,
Board of Agriculture, Helsinki, Finland, and Soil and Water Conservation Res Div, Agricultural Research Service.
Seppo E. Mustonen, and J. L. McGuinness.
U S Dep of Agr Tech Bull No 1389, 123 p, July 1968. 42 fig, 22 tab, 57 ref.

Descriptors: *Cover crops, *Evapotranspiration, *Humid areas, *Statistical models, *Watersheds (Basins), Lysimeters, Soil moisture, Water balance, Precipitation (Atmospheric), Solar radiation.
Identifiers: *Potential evapotranspiration, Scale weight lysimeter readings, Water budget.

An investigation was made of the problem of estimating evapotranspiration in a typical humid region with an abundant and evenly distributed monthly precipitation. Evapotranspiration models were derived from data obtained through large weighing lysimeters for which moisture storage change data were available. The models were then applied on natural watersheds to check the appropriateness of the models and to derive coefficients for use in watershed studies. Evapotranspiration data obtained this way was related to climate and water availability by the use of statistical models derived by multiple regression. The influence of evapotranspiration of different plant covers on watersheds was studied. Climatic variables used in computing daily lake evaporation were mean daily air temperature, mean daily dew point temperature, daily windspeed, and daily solar radiation. Scale weight readings from the lysimeter were correlated with neutron scattering and gypsum block measurements outside the lysimeter to obtain yearround estimates of daily soil moisture. Lysimeter evapotranspiration data obtained from these formulas were somewhat higher than those obtained from natural watersheds. (Llaverias-USGS)
W69-00939

PILOT EVAPOTRANSPIRATION STUDY: LYSIMETER DESIGN,
Hawaii Univ., Manoa.
Paul C. Ekern.
Tech Rep 13, Water Resour Res Center, Aug 1968. 26 p, 8 fig, 53 ref. OWRR Project A-010-Hi.

Descriptors: *Lysimeters, Equipment, Evaporation, *Evapotranspiration, Hydrologic cycle, Micrometeorology, Winds, *Fine-textured soils, *Soil water, Moisture availability, Soil temperature, *Consumptive use, Water requirements, Pressure measuring instruments, Tensiometers, *Sugarcane.

Based on field experience with hydraulic lysimeter for the evapotranspiration of pineapple, nylon reinforced butyl rubber bolsters formed hydraulic load cells to support 3 by 3 by 1.52-m-deep filled lysimeter for sugarcane. Stability was achieved by placing several of the bolsters at right angles to the others. Polyester resin, fiber glass reinforced tanks have paper honeycomb strengthened bottoms. Large tensiometers of Povic membrane were used to remove percolate to simulate field capacity of 0.1 bar in the low humic latosol. The open end manometers used for measurement of pressures in the cells must be protected from wind and temperature fluctuations.
W69-00981

DIFFUSION THROUGH MULTIPERFORATE SEPTA,
Richard Lee.
Water Resour Inst Rep, Conn A-002, June 1966. 4 p. OWRR Project A-007-Conn.

Descriptors: *Transpiration, *Stomata, Diffusion, Plants, *Leaves, *Plant physiology, Respiration, Biological membranes, Evapotranspiration.

Theories were tested on the dependence of membrane diffusion rates on pure size and number over the range of variables characteristic of leaf epidermis. Plant canopies are not passive evaporating surfaces. The regulation of water loss from plants is an important function of leaf stomata, and significant stomatal regulation occurs throughout the range of leafpore diameters. Leaf pores do not significantly interfere with one another in conducting water vapor or other gases. The diffusive conductance of small pores is more sensitive to diameter changes at larger apertures, permitting carbon dioxide exchange for photosynthesis without dehydration of the leaf mesophyll. In still air the external resistance over broad leaves limits control by stomata, but light drafts minimize this effect in field situations. Characteristic diffusion coefficients for leaf types, based on a careful study of leaf microstructure, physiology, and seasonal variation, is a rational basis for cover-type conversions or biochemical controls to reduce water loss.
W69-00988

THE AVAILABILITY OF SUB-SURFACE WATER IN MISSOURI FOR CONSUMPTIVE USE BY PLANTS,
Missouri Univ., Columbia, Soils Dept.
C. L. Scrivner, and Wayne L. Decker.
See also, Decker, Wayne L., 'Potential Evapotranspiration in Humid and Arid Climates,' reprinted from Conf Proc, Evapotranspiration and its Role in Water Resources Management, Dec 5-6, 1966. pp 23-26. Termination Rep, Nov 22, 1967. OWRR Project B-005-Mo.

Descriptors: Alluvium, Soil types, Water storage, *Evapotranspiration, Irrigation requirement, Irrigation effects, *Soil surveys, Climatology, Water requirements, Laboratory tests, Moisture uptake, Moisture content.
Identifiers: Soil maps, Missouri River Basin.

Using a reconnaissance technique which was developed for rapid and preliminary soil survey work, soil types from over 400,000 acres of land in the alluvium along the Missouri river were identified. Boundaries for each soil type are shown on maps in the appendix of this report and acreages associated with each soil type are also listed in the appendix. Concurrent laboratory examinations provided estimates of the water-holding capacities for each of the soil types. Less than 5% of the area had low storage capacities; while 60% of the area had storage capacities in excess of 6 in. of available water in the top 4 ft of soil. The requirement for irrigation of each soil was estimated. Using data from weather stations of the area, the requirement was obtained by simulating the daily water balance of each soil from measurements of rainfall and estimates of evapotranspiration. Soils with low storage capacities need more irrigation than those with high capacities. An attached reprint shows more than 10 in. of supplemental water required for 4 yr out of 10 for the former soil and less than 2 yr out of 10 for the latter soil types.
W69-00999

THE MECHANICS OF FLUID TRANSPORT IN VEGETATION,
Massachusetts Univ., Amherst.
For primary bibliographic entry see Field 02I.
For abstract, see .
W69-01002

AN APPRAISAL OF ADVECTION CONTRIBUTIONS TO OBSERVED EVAPORATION IN AUSTRALIA USING AN EMPIRICAL APPROXIMATION OF PENMAN'S POTENTIAL EVAPORATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia), Div of Land Research.
Eugene A. Fitzpatrick.
J Hydrol (Amsterdam), Vol 6, No 1, pp 69-94, January 1968. 26 p, 10 fig, 5 tab, 33 ref.

Descriptors: *Evaporation, *Vapor pressure, *Temperature, *Climatic data, Diurnal, Advection, Humidity, Arid lands, Correlation analysis, Radiation, Regression analysis, Energy, Evapotranspiration, *Approximation method, Regional analysis.
Identifiers: Western Australia, Tank evaporation, Energy balance, *Penman's potential evaporation.

A method was developed for obtaining an approximation of Penman's potential evaporation using data obtained in field studies of growth and water-use characteristics of cotton at Kununurra, Western Australia. Using daily data, a distinctive linear relationship between the weighted vapor pressure deficit and Penman evaporation was identified for periods with low advection. Reasonable close approximations of Penman's potential evaporation over periods of 10 days or longer could be made solely from temperature and vapor pressure data over a wide range of climatic environments in Australia. A regional appraisal of advective contributions to the observed or estimated rates of tank evaporation using energy balance considerations was difficult in Australia because of the paucity of radiation (or sunshine) and evaporation measurements over large parts of the continent. (Blecker-Ariz)
W69-01011

WATER CONSUMPTION BY PHREATOPHYTES,
Arizona Univ., Tucson. Dept. of Watershed Management.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-01012

ATTRACTION OF ATMOSPHERIC MOISTURE BY WOODY XEROPHYTES IN ARID CLIMATES,
Volcani Institute of Agricultural Research, Rehovot, Israel.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-01014

ROLE OF ANTITRANSPIRANTS WITH SPECIAL REFERENCE TO WATER TURN-OVER IN ARID PLANTS,
Central Arid Zone Research Institute, Jodhpur, India.
A. N. Lahiri.
Annals of Arid Zone, Vol 5, No 1, pp 97-104, March 1966. 8 p, 1 tab.

Descriptors: *Water loss, Arid lands, *Desert plants, *Transpiration control, Photosynthesis, Soil-water-plant relationships, soil moisture, *Retardants, Monomolecular films, Evaporation control.
Identifiers: *Antitranspirants.

Water loss by transpiration under desertic conditions is a serious problem because of the great bulk that is lost to the atmosphere. A review of various antitranspirants with particular reference to water turn-over in arid plants is given. The requirements for a successful antitranspirant are listed. The effect of antitranspirants on photosynthesis were discussed. It was suggested that plant antitranspirants have a great possibility for moisture conservation in arid and semi-arid areas where native plants commonly transpire at a very fast rate until low soil moisture reduces the rate of transpiration. (Affleck-Ariz)
W69-01020

A TECHNIQUE TO DETERMINE EVAPORATION FROM DRY STREAM BEDS,
Ariz. Univ., Tucson. Institute of Atmospheric Physics.
Michael J. Fox.
J of Applied Meteorology, Vol 7, No 4, pp 697-701, Aug 1968. 4 p, 5 fig.

Descriptors: *Evaporation, Dry seasons, *Streambeds, Thermometers, Temperature, Winds, *Hydrologic budget, Anemometers, Energy budget, *Equations, Meteorological data, *Statistical methods, Soil moisture, Water balance, Lysimeters.
Identifiers: Hydrologic balance.

In the desert southwest washes or dry stream beds are numerous. For one or two days after thunderstorm flooding, up to 7 mm. of water evaporates each day. While insignificant in a limited area and time, this evaporation, when totaled over a large area and long period, may be important in the hydrological balance of arid regions. A technique is described to determine 24 hr. stream-bed evaporation subject to the constraints that it be inexpensive, uncomplicated, and accurate to within plus or minus 20%. The result of statistical evaluation of the prediction equation on the experimental data gave an average percentage error of 13% and a standard error of 0.88 mm. (Affleck-Ariz)
W69-01026

LYSIMETER AND WATERSHED EVAPOTRANSPIRATION,
Board of Agriculture, Helsinki, Finland, and Agricultural Research Service, Coshoeton, Ohio.
Seppo E. Mustonen, and J. L. Mc Guinness.
Water Resources Res, Vol 3, No 4, pp 989-996, 1967. 8 p, 2 fig, 3 tab, 12 ref.

Descriptors: *Evapotranspiration, *Lysimeters, *Statistical models, Regression analysis, Hydrologic budget, Small watersheds.

A statistical model was derived by regression analysis for permanent grass lysimeter evapotranspiration, using lake evaporation, soil moisture, and precipitation as independent variables. Measured evapotranspiration was greater than values estimated from water budgets on small watersheds. Differences for permanent grass and grain crops were greatest at planting time when the ground was bare. Evapotranspiration was about 1/2 of normal when hay was cut; it returned to normal in about a month. Reforestation increased evapotranspiration about 35% on a reforested study plot. (Knapp-USGS)
W69-01054

GENERALIZED ESTIMATES OF FREE-WATER EVAPORATION,
Weather Bureau, Washington, D. C. and Agricultural Research Service, University Park, Pa.
M. A. Kohler, and L. H. Parmele.
Water Resources Res, Vol 3, No 4, pp 997-1005, 1967. 9 p, 7 fig, 1 tab, 27 ref.

Descriptors: *Evaporation, *Reservoir evaporation, *Lakes, Mass transfer, Energy budget, Environmental effects, Solar Radiation, Temperature.

A modified method for deriving free-water evaporation estimates from network observations of air temperature, dew point, wind movement, and incoming minus reflected radiation is presented. Taking into account the difference between air and water temperature in computing emitted radiation from the water surface, the expression is an improvement over the original Penman type equation where observation of net radiation over the actual water surface is lacking. The accuracy of the method depends on the applicable mass transfer wind function. Techniques are derived to adjust for the effects of advected energy and heat storage when applying the free-water evaporation estimate to actual water bodies. Computations of lake evaporation made with the modified method for a number of locations where verification data are available indicate that the relation provides a suitable basis for estimating actual evaporation without the expense of continuous over-water observations. (Author)
W69-01055

THE HYDRODYNAMIC AND ENERGY BUDGET ASPECTS OF PAN EVAPORATION.
Cornell Univ, Ithaca, N Y.
Wilfried Brutsaert.
Tech Rep 7, Water Resour Center, Aug 1967. 38 p, 1 fig, 13 tab, 23 ref. OWRR Project A-004-NY.

Descriptors: *Evaporation, Evapotranspiration, *Evaporations pans, Transpiration, Mass transfer, Solar radiation, Wind velocity, Winds, Shear stress, *Energy budget, Diffusion, *Hydrodynamics.

An analysis is presented of experimental evaporation data which were obtained with shallow, square pans of different sizes and colors. The results are given of the computations of regression analysis relating evaporation with the difference between the water vapor pressure at the water surface and in the air, pan size, wind speed at various elevations and shear stress. These relationships are expressed by different equations for mass transfer whose functional form is widely accepted in the literature or derivable by means of theoretical diffusion models. The shear stress--or the friction velocity--was calculated in 4 different ways, namely by solving the following wind speed profile laws with wind speed data at different elevations; the logarithmic, the log-linear, the log-square root and the log-exponential law. A comparison is presented of the correctness of fit obtained with the different models.
W69-01136

ESTIMATING INCIDENT TERRESTRIAL RADIATION UNDER ALL ATMOSPHERIC CONDITIONS,
Environmental Science Services Administration, Washington, D C, Office of Hydrology.
E. A. Anderson, and D. R. Baker.
Water Resources Res, Vol 3, No 4, pp 975-988, 1967. 14 p, 13 fig, 3 tab, 20 ref.

Descriptors: *Atmospheric physics, *Radiation, *Evapotranspiration, Energy transfer, Meteorology, Hydrology, Data collections, Humidity, Snowmelt, Instrumentation.
Identifiers: *Atmospheric radiation, Energy balance, Data network.

The application of a complete energy balance to computations of evaporation or snowmelt requires radiation data, of which there is presently reasonable coverage from a network of incident solar radiation stations. A network of all-wave radiometers does not exist. Therefore, to apply the energy budget technique to hydrological problems, incident long-wave radiation must be estimated. An empirical equation is developed by which incident long-wave radiation can be computed from observations of surface air temperature, vapor pressure, and incident solar radiation. Comparisons of estimated and observed incident long-wave radiation at 6 sites lead to the following conclusions: (1) The equation should give results comparable within a few percent on a 6-months basis or longer; (2) For any specific atmospheric condition, there seems to be no tendency for the equation to over or under compute or give increased scatter; (3) When data

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for 6 months or more are analyzed, correlation coefficients of about 0.90 were obtained between computed and observed daily radiation values. (Lang-USGS)
W69-01193

2E. Streamflow and Runoff

HYDROLOGICAL DATA AND PEAK DISCHARGE DETERMINATION OF SMALL HAWAIIAN WATERSHEDS: ISLAND OF OAHU,
Hawaii Univ., Honolulu.
Wu I-Pai.
Water Resour Res Center Tech Rep 15, Dec 1967. 97 p, 26 fig, 13 tab, 46 chart, 43 ref, append. OWRR Project B-003-Hi.

Descriptors: *Watersheds, Overland flow, Rational formula, Surface runoff, *Rainfall, Streamflow, Design criteria, *Hydrology, Flood forecasting, Geomorphology, Soil structure, Land utilization, Rain gages, Runoff forecasting, Stream gages.
Identifiers: *Flood hydrology, Flood frequency, Multiple regression, Flow estimate, Hawaii, Oahu.

Basic hydrological data including rainfall, runoff, historical flood, watershed characteristics, soil type, and land use of Hawaiian small watersheds on Oahu have been compiled and analyzed. Frequency analysis for annual peak discharge was made for 23 small watersheds on Oahu by using Gumbel's extreme value theory. A regional flood formula has been derived for Honolulu and between mountain ranges of the island of Oahu through the use of multiple regression. The regional flood formula expressing peak discharge as a function of watershed area, length and height and a precipitation index defined as 100-yr, 24-hr rainfall in in. can be used to estimate peak discharges for ungaged areas. The rational formula which is currently used for drainage areas less than 100 acres has been evaluated through the study of overland flow.
W69-00709

RECESSION CHARACTERISTICS OF IOWA STREAMS: PART I - TEMPORAL AND AREAL DISTRIBUTION OF RECESSION CONSTANTS,
Iowa State Univ., Ames.
J. W. Howe.
Water Resour Res Inst Rept, June 1966. 150 p, 144 fig, 1 tab. OWRR Project A-004-Ia.

Descriptors: *Streams, *Streamflow, Forecasting, Irrigation, Water users, *Streamflow forecasting, Hydrometeorological station, *Iowa, *Low flow, *Recession curves, Summer, Withdrawal.

This report covers behavior of Iowa in low-water periods during the crop-growing season, May to Sept inclusive. All such periods of 10 days or more in length were analyzed to determine the recession constants. Results are shown on a map of the State and indicate a considerable uniformity of behavior during each of the summer months. Data contained in this report should enable prediction of groundwater streamflow with reasonable accuracy for a period of 1 to 2 weeks in advance if no rain falls, and thus make it possible to give an irrigator several days to a week's notice of the time when the withdrawal from a stream must be terminated. This phase of the project discovers a consistency of recession coefficients at existing stream gaging stations in the summer months which should be useful in predicting the time of occurrence of particular low-water flows. The second phase of investigation will deal with the relation of magnitude of low-water flow at the beginning of a period of recession to associated parameters such as basin area, antecedent rainfall, and soil types.
W69-00718

THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL,
Oklahoma State University, Norman, Agr. Eng. Dept.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-00915

PLANFORM ANALYSIS OF MEANDERING RIVERS,
Purdue University, Lafayette, Indiana.
G. H. Toebes, and T. P. Chang.
Purdue Univ Eng Reprints CE 242, pp 362-369, Feb 1968. 8 p, 5 fig. OWRR Project A-003-Ind.

Descriptors: *Meanders, *Time series analysis, Frequency analysis, Discharge (Water), Width, Streamflow, Hydraulic similitude, Hydraulic properties.
Identifiers: Ergodic properties.

The planform of meandering rivers is analyzed statistically to improve the analyses made by deterministic approaches and to gain an idea of the relative significance of deterministic and random planform components. The White River Valley in Indiana was selected for a field study and time-series analysis. The data appeared to be non-stationary and spectral characterization of meander planform is likely to require trend removal. A substantial random component is present and the relation between hydrology and meander shape is equally random. Cross-correlation of local planform with local width, depth, slope, and other local factors appears necessary, but these dimensions are difficult to measure reliably. Time trends in river hydraulic behavior are also unpredictable but necessary to define. So far, results show that the search for deterministic equations may be futile. (Knapp-USGS)
W69-00917

SOME RECENT STUDIES ON NUMERICAL FLOOD ROUTING.
North Carolina State University, Raleigh.
Michael Amein.
3rd Annual Amer Water Resources Conf Proc, pp 273-284, Nov 8-10, 1967. 6 fig, 11 ref.

Descriptors: *Flood routing, *Flood forecasting, *Mathematical studies, *Digital computers, Hydrographs, Unsteady flow.
Identifiers: Numerical flood routing.

The results of an investigation of fundamental aspects of numerical flood routing based on the solution of the equations of unsteady flow are presented. Brief reviews of the approximate methods and their solutions, and discussions of the explicit method, the characteristic method, and the implicit method, including factors affecting the stability and accuracy of the solutions, are given. An example of a flood flow problem is solved using the IBM 360 computer. The times of arrival and the depth values of flood peaks calculated by the various methods are essentially the same. The explicit method is the least efficient in computer time, but the simplest to use. (Knapp-USGS)
W69-00922

STREAM TEMPERATURE STUDY, NORTH FORK SNOQUAIMIE RIVER, WASHINGTON,
Washington Univ., Seattle, Civil Eng. Dept.
Ronald E. Nece.
Tech Rep 23, Dep Civ Eng, 1967. 49 p, 9 fig, 3 tab, 11 ref. OWRR Project A-012-Wash.

Descriptors: Heat budget, Solar radiation, Air temperature, *Water temperature, Hydrology, *Rivers, Running waters, Hydrologic data, Hydrometeorological station, Stream flow records, Streams, Temperature.
Identifiers: *Micrometeorology, Snoqualmie River, Wash.

The upper basin of the North Fork of the Snoqualmie River was used for a study of stream temperatures in the headwater regions of a typical Pacific Northwest mountain river. Water temperature, stream flow, and climatological data are given for the heating season of calendar year 1967. A simplified procedure is suggested for predicting water temperatures at a given station on such a stream. The suggested procedure uses a typical heat energy-budget approach; a number of terms usually considered in heat budget calculations are omitted, while provision is made for consideration of remains to be verified because stream travel times required in the calculations have yet to be obtained on the study river. Measurements of air temperatures and of solar radiation in the test basin indicate that these variables may indeed be satisfactorily predicted on the basis of conventional data obtained at the federal weather station in the same general region.
W69-00977

SEQUENTIAL STUDY OF DESERT FLOODING IN THE WHITE MOUNTAINS OF CALIFORNIA AND NEVADA,
Montana Univ., Missoula, Dept. of Geography.
Chester B. Beaty.
U. S. Army NATICK Laboratories, Natick, Mass., Tech Rept ES-37, January 1968. 98 p, 55 fig, 1 map, 11 tab, 21 ref, 1 append.

Descriptors: Canyons, Deserts, *Cloudburst, California, Channel morphology, Alluvial channels, *Debris avalanches, Flood forecasting, *Flash floods, Nevada, Snowmelt, Flood plains, Rainfall-runoff relationships, Wet seasons, *Intermittent streams, *Geomorphology, Storm runoff, Streams.
Identifiers: White Mountains, California and Nevada, Alluvial fans, Trunk canyons.

Study of desert flooding and circumstances under which it is likely to be a hazard to activities in and near desert mountains was undertaken in 1956-57 in the White Mountains of California and Nevada. Ten years later the area was restudied to determine extent and nature of land form changes that had occurred during the intervening decade. Three physiographic characteristics influence flooding behavior in a desert stream system. They are: truck canyon profile, amount of debris on the floor of the trunk canyon and the width of the lower canyon and canyon mouth. The area of greatest flooding danger on a desert alluvial fan is a radial zone extending from the apex toward the margin, flanking and including the active channel. (Blecker-Ariz)
W69-01006

INFLUENCE OF SOME PARAMETERS OF A PRISMATIC FLOOD-PLAIN CHANNEL ON THE RATE OF PROPAGATION OF THE CREST OF RELEASE WAVES (NUMERICAL EXPERIMENTS),
M. I. Rusinov.
Soviet Hydrol: Selec Pap, No 2, pp 135-149, 1967. 15 p, 6 fig, 1 tab, 19 ref. Translated from Trudy GGI, No 140, pp 64-82, 1967.

Descriptors: *Unsteady flow, *Open channel flow, *Floods, *Computer models, Digital computers, Hydrographs, Analytical techniques, Synthetic hydrology, Flood plains, Roughness (Hydraulic), Slopes.
Identifiers: USSR, Flood wave propagation, Flood crests.

Flood wave propagation was studied with an algorithmic digital computer model of hypothetical prismatic channels and flood plains. The influences of the width of the flood plain, depth of flooding, and roughness on flood wave crest velocity were analyzed, and were constructed to represent the results. The influence of each variable is discussed in detail. (Knapp-USGS)
W69-01038

INFLUENCE OF UNSTEADY FLOW ON THE VERTICAL DISTRIBUTION OF AVERAGED VELOCITIES (ACCORDING TO FIELD OBSERVATIONS BY THE STATE HYDROLOGIC INSTITUTE ON THE SVIR RIVER),
N. N. Fedorov.
Soviet Hydrol: Selec Pap, No 2, pp 149-152, 1967. 4 p, 1 fig, 4 ref. Translation from Trudy GGI, No 140, pp 136-139, 1967.

Descriptors: *Unsteady flow, *Open channel flow, *Turbulent flow, *Reservoir operation, Velocity, Distribution patterns.
Identifiers: USSR, Velocity-depth distirbution.

The influence of unsteady flow on the vertical velocity-distribution was analyzed in the lower pool of the Nizhne-Svir Hydroelectric Power Plant in winter, 1961. It was found that the average velocity-depth distribution curve does not change significantly upon passage of a release wave but when a new steady state regime is established, a new velocity-depth curve is also established. (Knapp-USGS)
W69-01039

ANALYSIS OF RELATIONSHIPS BETWEEN WATER DISCHARGES AND LEVELS DURING THE PROPAGATION OF RELEASE WAVES IN A PRISMATIC CHANNEL (NUMERIC EXPERIMENTS),
A. A. Ivanova.
Soviet Hydrol: Selec Pap, No 2, pp 121-135, 1967. 15 p, 7 fig, 3 tab, 16 ref. Translation from Trudy GGI, No 140, pp 44-63, 1967.

Descriptors: *Unsteady flow, *Channel flow, *Waves (Water), *Equations, Flow profiles, Model studies, Hydraulic properties, Hydrographs.
Identifiers: Saint Venant equations.

Flow in trapezoidal and rectangular section channels was studied to evaluate various approximate solutions of the Saint Venant unsteady flow equations and to determine the influence of channel storage, channel sectional shape, roughness coefficient, slope, and time profile of the flow release. Since the system of Saint Venant equations, which describes the process of unsteady flow, is nonlinear and cannot be solved analytically in the general form, it is impossible to determine analytically the influence of each of the factors in this complex multiple-factor process. This can be done only on the basis of various assumptions, giving an approximate picture of the influence of these factors. Waves progressing downstream after an abrupt release are represented by loops in the hydrograph of the flow. As a wave diminishes downstream, the hydrograph loop lengthens and thins, until at a sufficient distance from the release point, the wave disappears and the hydrograph curve becomes single valued. Partial data from 200 experimental releases are plotted, and the forms of solutions to unsteady flow equations that may yield waves or hydrograph loops are discussed. (Knapp-USGS)
W69-01040

A THERMODYNAMIC ANALOGY FOR MEANDER SYSTEMS,
U S Geological Survey and Illinois Univ., Urbana.
For primary bibliographic entry see Field 02J.
For abstract, see .
W69-01048

SIMPLIFIED VERSUS OPTIMUM UNIT HYDROGRAPHS--ONE COMPARISON,
Georgia Institute of Technology, Altanta.
Willard M. Snyder.
Water Resources Res, Vol 3, No 4, pp 947-948, 1968. 2 p, 2 tab, 4 ref.

Descriptors: *Unit hydrographs, Hydrograph analysis, Analytical techniques, Mathematical studies, Least squares method.
Identifiers: Iteration methods, Curve fitting.

A unit hydrograph is derived from a record storm previously analyzed for the optimum realizable unit hydrograph. The simplified curve-fitting procedures a more rational appearing unit hydrograph in this case study. The method employs a simple iterative procedure based on calculating corrected values for estimated P sub e from a unit hydrograph, and then constructing a new unit hydrograph using the new value of P sub e. The iteration may be repeated as often as desired for further refinement. (Knapp-USGS)
W69-01052

THE RELATION BETWEEN MAINSTREAM LENGTH AND AREA IN DRAINAGE BASINS,
IBM Watson Research Center, Yorktown Heights, N. Y.
J. S. Smart, and A. J. Surkan.
Water Resources Res, Vol 3, No 4, pp 963-974, 1967. 12 p, 6 fig, 6 tab, 19 ref.

Descriptors: *Watersheds (Basins), *Drainage patterns (Geologic), *Meanders, Geomorphology.
Identifiers: Drainage basin characteristics, River classification, Stream lengths, Stream numbers, Stream sinuosity.

Analyses of small drainage basins show that variations in stream sinuosity can affect the value of the exponent n prime in Hacks length-basin area relationship L prime = C (A to the power n prime). A simple approximate formula relates mainstream length, sinuosity, basin shape, and basin area and shows how the contributions of sinuosity and shape variation may be separated and evaluated. The generally accepted statement that drainage basins are more elongated with larger area needs further investigation. (Knapp-USGS)
W69-01053

MATHEMATICAL ASSESSMENT OF SYNTHETIC HYDROLOGY,
U. S. Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01056

SYNTHETIC HYDROLOGY BASED ON REGIONAL STATISTICAL PARAMETERS,
U. S. Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01057

FLOODS FROM SMALL DRAINAGE AREAS IN CALIFORNIA--A COMPILATION OF PEAK DATA, OCTOBER 1958 TO SEPTEMBER 1967.
U S Geological Survey.
Arvi O. Waananen.
U S Geol Surv, Water Resources Div, 143 p, July 1968. 41 fig, 2 tab.

Descriptors: *Data collections, *Floods, *Small watersheds, *California, Discharge measurement, Stream gages, Hydrographs, Precipitation (Atmospheric).
Identifiers: Annual peak stage.

As a part of the cooperative agreement between the California Department of Water Resources and the U S Geological Survey, an investigation of the magnitude and frequency of floods from drainage areas generally of less than 10 sq mi was begun by the USGS in 1958. By the end of 6 years of study, 300 gaging stations were installed, all with crest-stage gages. Annual peakflows, drainage area, elevation of basin, length of basin, slope of basin, vegetal cover, geology of basin, shape of basin, rainfall, and area of lakes and ponds are tabulated. (Knapp-USGS).
W69-01059

AN APPLICATION OF PRINCIPAL COMPONENT ANALYSIS AND FACTOR ANALYSIS IN THE STUDY OF WATER YIELD.
Tennessee Univ, Knoxville, Tennessee.
Guillermo Diaz, J. I. Sewell, and C. H. Shelton.
Water Resources Research, Vol 4, No 2, pp 299-306, April 1968. 7 tab, 13 ref.

Descriptors: *Water yield, Watersheds, Ohio, Texas, Soil types, Regression analysis.
Identifiers: *Principal component analysis, *Factor analysis, Area, Slope, Cultural practices, Land capability, Varimax rotation.

Principal component and factor analysis were applied to annual precipitation and runoff data of fourteen watersheds from Coshocton, Ohio, and seven watersheds from Riesel, Texas. The objective was to identify the factors affecting the water yield of these watersheds and to determine the relative importance of the identified factors. From the Ohio watersheds, the rotated factor analysis suggested that watersheds area and slope were, in that order, the two most important factors affecting water yield. For the Texas watersheds, three almost equally important watershed factors were identified as the soil type, cultural practices, and land capabilities. A stepwise regression of runoff-precipitation ratios of the Ohio data on area-slope variables substantiated the effects of area and slope on runoff that were determined in the factor analysis. (Seneca-Rutgers)
W69-01064

STEADY AND UNSTEADY EFFECTS ON DISCHARGE IN A RIVER CONNECTING TWO RESERVOIRS.
Cornell Univ, Ithaca, N Y.
James A. Liggett, and Walter H. Graf.
Tech Rep 5, Water Resour Center, Aug 1967. 10 p, 9 fig, 4 ref. OWRR Project A-009-NY.

Descriptors: Flood routing, Shallow water, Equations, *Unsteady flow, *Steady flow, Roughness coefficient, *Open channel flow, *Streamflow, *Discharge measurement, Lake Huron.
Identifiers: Finite difference method, St Clair River (Michigan).

The effects of the frictional coefficient, lake levels and unsteady flow are considered for a river which joins 2 reservoirs. These effects are studied numerically by using a somewhat idealized model of the St. Clair River, which connects Lake Huron to Lake St. Clair. The analysis shows that each of these factors has a large effect on the flow. An unsteady flow analysis of the river is probably necessary if the lake levels are subject to any major fluctuations. A method is proposed by which the frictional constant can be determined accurately. The adjustment process of the frictional constant can be either internal or external to the machine computation. If the constant is allowed to vary with both depth and distance along the river, quite a number of runs will be necessary to determine it accurately. The present study indicates (but does not prove) that continuous and accurate geometrical data (cross section, slope, etc.) are probably not necessary for such a program.
W69-01137

A LABORATORY INVESTIGATION OF OPEN-CHANNEL DISPERSION PROCESSES FOR DISSOLVED, SUSPENDED, AND FLOATING DISPERSANTS,
U S Geological Survey.
W. W. Sayre, and F. M. Chang.
U S Geol Surv Prof Pap 433-E, pp E1-E71, 1968. 71 p, 60 fig, 11 tab, 51 ref.

Descriptors: *Dispersion, *Open channel flow, *Dissolved solids, *Suspended load, *Floating, Waste disposal, Path of Pollutants.
Identifiers: Open-channel dispersion.

A series of experiments conducted in a rigid-boundary laboratory flume having an artificially

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roughened bed compared longitudinal dispersion of suspended silt-size sediment particles with longitudinal dispersion of a fluorescent dye solution and longitudinal and lateral dispersion of floating polyethylene particles. The longitudinal and lateral dispersion processes for dissolved dispersants and floating particles converged to a Fickian-type diffusion process quite rapidly with increasing dispersion distance. The values of the longitudinal dispersion coefficient for the dye closely correspond to J W Elder's theory. Except in the sediment-dispersion experiments, the dispersion coefficients were approximately proportional to the product of the depth and the shear velocity. The longitudinal dispersion process for suspended silt-size particles resembles the process for the dye, but is modified by the particles settling toward the slower moving flow near the bed and eventually depositing on the bed. The longitudinal distribution of particle deposition can be calculated using T R Camp's the theory of the influence of turbulence on sedimentation in settling tanks. The confining effect of the sidewalls on the lateral distribution of dye can be accounted for satisfactorily by the reflection-superposition principle. (Knapp-USGS)
W69-01180

SIMULATION OF OVERLAND FLOW ON SHORT FIELD PLOTS,
U. S. Department of Agriculture, Agricultural Research Service, and Purdue University, Lafayette, Ind.
G. R. Foster, L. F. Huggins, and L. D. Meyer.
Amer Geophys Union, 49th Annu Meeting, Washington, D. C., Apr 8-11, 1968 (Pap), 10 p, 1968. 5 fig, 1 tab, 4 ref. OWRR Project B-003-IND.

Descriptors: *Overland flow, *Model studies, *Continuity equation, *Uniform flow, *Darcy-Weisbach equation, Fallowing, Roughness coefficient, Roughness (Hydraulic), Rainfall, Discharge (Water), Hydrographs, Slopes.
Identifiers: Kinematic wave theory.

An overland flow model based on the kinematic wave theory was developed to analyze overland flow on short, very rough erosion plots. Simulated rainfall was applied at 2.5 in/hr through nozzles that spray downward as they move across the plot. Plot sizes were 35 ft long and 10 and 12 ft wide; the surface condition was fallow. Field hydrographs were used to estimate retention storage and the Darcy-Weisbach coefficient of friction. The model includes variable point infiltration rate and a variable coefficient of friction, the 'drying up' of the upstream end of the slope during recession, and a variable area infiltration rate that is a function of the water surface area during recession. These were used in the model to simulate hydrographs which were compared with field hydrographs to test the concepts used in the model. The model with a constant Darcy-Weisbach coefficient of friction or Manning's n adequately describes overland flow on short erodible slopes. (Knapp-USGS)
W69-01182

REVIEW AND ANALYSIS OF RAINFALL AND RUNOFF DATA FOR SELECTED WATERSHEDS IN MINNESOTA,
Minn Univ, Anthony Falls Hydraul Lab, Minneapolis.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01187

ANALYSIS OF HYDROLOGIC SYSTEMS,
Metcalf and Eddy, Boston, Mass, and Virginia Polytech Inst, Blacksburg.
Tsung Ting Chiang, and J. M. Wiggert.
Virginia Polytech Inst Water Resources Res Center Bull 12, 74 p, May 1968. 36 fig, 49 ref, 1 append. OWRR Project A-013-Va.

Descriptors: *Runoff, *Rainfall-runoff relationships, *Runoff forecasting, *Systems analysis, Simulation analysis, Synthetic hydrology.
Identifiers: Process dynamics, Information theory.

The feasibility of applying systems analysis techniques to hydrology by examining the hydrologic runoff process in terms of fundamental process dynamics is examined. In any system, the output and the input signals may be related by a transfer function, the ratio of the Laplace transform of the output function to the Laplace transform of the input function. If the transfer function of a system is known, the output may be calculated easily from given or assumed input. For simple systems, the transfer function may be derived theoretically by the physical characteristics of the system, but for complex systems, or from a system whose physical relations are not surely known, theoretical formulation becomes impossible, and an experimental approach is called for. The use of analog and digital computers has made possible the application of systems analysis to physical systems that only a few years ago were impossible to analyze. Simplified hydrologic laboratory models were used in developing, the mathematical models. Impervious catchments of simple rectangular configuration, sloping 0-8 deg, supplied with uniform rainfall from nozzles, were used and evaporation was neglected. A general transfer function was developed for hydrologic runoff systems. (Knapp-USGS)
W69-01191

2F. Groundwater

WATER WELL YIELDS FROM CRYSTALLINE ROCKS OF NORTHERN NEW JERSEY,
Rutgers Univ., New Brunswick.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-00707

ESTIMATION OF GROUND-WATER CONFIGURATION NEAR PAHALA, HAWAII USING ELECTRICAL RESISTIVITY TECHNIQUES,
Hawaii Univ., Honolulu.
Donald M. Hussong, and Doak C. Cox.
Water Resour Res Center Tech Rep 17, Aug 1967. 35 p, 12 fig, 1 tab, 57 ref. OWRR Project B-005-Hi.

Descriptors: *Ground water, *Water table, *Resistivity, Geophysics, Dikes, Saline water-fresh water interfaces, *Hawaii.
Identifiers: Kau, Hawaii.

In 1965 Water Resources Research Center, University of Hawaii, began development of necessary equipment to explore feasibility of an extensive resistivity exploration program. Subsequent funding permitted application of the technique toward solution of a ground-water problem in Pahala. A series of 14 electrical soundings was completed at Pahala, Sept 1966, to determine the extent and causes of an anomalous high water table. Four of the soundings indicated the limits of this underground reservoir to be at least 3500 ft east and 2500 ft south of a Maui-type well shaft. The southern extent of high head ground water suggests NE-SW trending of the eruptive fissure vent about 4000 ft SE of the well as a likely hydrologic barrier. Other soundings, indicate intermediate water tables along the direction of the strike of the vent indicating a series of similarly trending dikes forming steps of water entrapment dropping toward the ocean. North of the hypothetical sequence, a set of somewhat confused soundings indicate what may be ancient buried soil or ash surfaces serving as impermeable boundaries presenting direct normal ground-water flow from Pahala SW above the dikes to the ocean south of Punaluu.
W69-00710

SUBSURFACE FLOW IN A SOUTHERN ILLINOIS FRAGIPAN SOIL,
Illinois Univ., Urbana.
W. R. Boggess, and Elon S. Verry, Jr.
Water Resour Center Rep, Feb 1967. 51 p, 22 fig, 6 tab, 32 ref, append. OWRR Project A-009-Ill.

Descriptors: *Groundwater flow, Seepage, Soil moisture, Geology, *Perched water table, Illinois, *Subsurface flow.
Identifiers: Fragipan soil.

Based on plot determinations, subsurface flow provides a significant component of total water yield, comprising 29% of the direct runoff and about 1/5 of the total water, applied as artificial rainfall to plots whose soil moisture storage capacity was satisfied. Measurable subsurface flow lasted for 36 hr, followed by some dripping for an additional 12 hr. Such conditions occur during the winter and early spring when evapotranspiration is at a minimum. Subsurface flow in the Grantsburg and similar soil series is caused by a well-developed fragipan impeding downward movement of water in the profiles. Following recharge during the fall and winter, these soils may develop a perched water table, causing tillage difficulties if it persists into the spring months. The fragipan acts as a barrier to ground-water recharge by routing subsurface flow to stream channels, or to soil surface on severely eroded slopes. As a result, ground-water resources of the southern Illinois uplands are poor and streamflow is very low or nonexistent during the summer and fall. Towns away from main watercourses often depend on impoundments to provide water for their needs. Data indicate that from 1/3 to 1/4 of the direct runoff into such impoundments results from subsurface movement of water.
W69-00717

THE PRESENT AND FUTURE GROUND WATER SUPPLY OF THE BATON ROUGE AREA,
Louisiana State Univ., Baton Rouge.
Raphael G. Kazmann.
Louisiana Water Resour Res Inst, Tech Rep 2, Sept 1967. 36 p, 8 fig, 7 tab, 11 ref. OWRR Project B-001-La.

Descriptors: *Water supply, Economics, *Groundwater recharge, Legal aspects, Hydrogeology, Aquifers, *Encroachment, Estimated cost, Water management (Applied), Louisiana.

Salt water encroachment in the Baton Rouge aquifers may be reduced or stopped by decreasing the net offtake from each aquifer that must be protected. Replacement water is available from the alluvium of the Mississippi River. Amite or Comite Rivers can also supply all or part of the replacement water, either directly or through spreading grounds utilizing the water from one or both rivers. The cost of providing suitable water from the Mississippi alluvium would range from 7 cents/thousand gallons for treated domestic water to as little as 3 cents/thousand for aerated and filtered industrial water. The work now in progress will provide descriptions of alternative projects and water costs associated with each. Several phases of the multidisciplinary Baton Rouge study are described in detail, as well as preliminary results and the plans for the final phases of the work.
W69-00720

THE RECENT ALLUVIUM OF THOMAS AND DUNCAN POINTS,
Louisiana State Univ., Baton Rouge.
Joseph D. Martinez.
Louisiana Water Resour Res Inst, Tech Rep 1, June 1967. 24 p, 12 fig, 3 plate, 13 ref. OWRR Project A-004-La.

Descriptors: Geologic formations, *Aquifers, *Freshwater, Water supply, *Alluvium, Natural recharge, *Louisiana.

Available borings and reports concerning the Mississippi River alluvium near Baton Rouge, Louisiana, are examined and interpreted. Two particular areas, Thomas Point-Devil's Swamp and Duncan Point, contain sands which are potential sources of naturally-filtered river water. Due to the scarcity of reliable borings in the Thomas Point-Devil's Swamp area, subsurface data from nearby similar areas are extrapolated. Two of the 12 figures and 3 plates analyze the frequency of depths to top of the sand obtained from borings. At Duncan Point, the potential aquifer sand is estimated to

extend from -20 to below -200 feet mean sea level. Thomas Point, more difficult to interpret, probably has sand from -95 (possibly -65) down to -150 feet msl or lower. Additional borings are needed.
W69-00722

EFFECTS OF INDUCED STREAMBED INFILTRATION ON WATER LEVELS IN WELLS DURING AQUIFER TESTS,
Minnesota Univ., Minneapolis.
William C. Walton, and Earl A. Ackroyd.
Water Resour Res Center Bull 2, June 1966. 43 p, 21 fig, 4 tab, 25 ref. OWRR Project A-010-Minn.

Descriptors: *Surface-groundwater relationships, Influent streams, Rivers, Streambeds, Streamflow, Aquifers, *Artificial recharge, *Water table, Drawdown, Groundwater recharge, *Induced infiltration, *Analog computers, Permeability, Storage coefficient.

Electric analog computers, simulating streambed as an area of recharge with natural conditions, were used to appraise accuracy of estimated effects of induced infiltration on water levels based on image well theory. Electric analog computers for 2 aquifer test sites where field data were available were constructed. Selected aquifer tests involve 2 extreme aquifer-stream situations, i.e., where the cone of depression spreads beneath and beyond the entire streambed and where the cone of depression spreads only part way beneath the streambed. Analog computers consist of analog models and excitation-response apparatus. Analog models are scaled-down versions of aquifer-stream situations. During induced infiltration aquifer tests, the image-well theory closely describes drawdowns on land sides of streams with a high degree of accuracy. Drawdowns beneath or beyond the streambed and streambed areas of infiltration based on image-well theory are not observed in the field. However, streambed infiltration rates per foot of head loss based on hypothetical drawdowns computed with image-well theory seem empirically correct. Additional research recharge through streambeds partially penetrating aquifers and having finite widths, under varying stream-stage and water-level conditions is needed.
W69-00723

DEVELOPMENT OF DEEP MONITORING STATIONS IN THE PEARL HARBOR GROUND WATER AREA ON OAHU,
Hawaii Univ., Honolulu.
Doak C. Cox, and Chester Lao.
Water Resour Res Center, Tech Rep 4, March 1967. 32 p, 11 fig, 6 tab. OWRR Project A-011-Hi.

Descriptors: Water quality, Aquifers, Salinity, Wells, Water wells, Bosalts, Test procedures, *Deep wells, *Sampling, pH, *Monitoring, *Groundwater, *Logging (Recording).
Identifiers: Hawaii, *Well logging, Well hydrograph, Oahu, Hawaii, *Puuloa Test Well, Hawaii, *Ewa Beach Test Well, Hawaii.

Two deep wells, one at Puuloa and the other at Ewa Beach in the Pearl Harbor area were drilled through the thick sedimentary cap into Koolau basalt, and have been readied for multiple-zone recording of water levels and water quality. Plastic pipes were lowered into the wells to selected depths determined by core composition and electric well logs. Gravel and beach sand were used selectively to backfill the wells. Thirteen sampling tubes were installed in the Puuloa well, and 7 sampling points were placed in the main well at Ewa Beach. A shallow auxiliary well was also drilled at Ewa Beach. Evidence from preliminary development of the deep aquifer at Ewa Beach indicates the possible existence of a thin layer of fresher water floating on water of nearly sea water composition. Water levels are being monitored in this aquifer and show a tidal efficiency of approximately 15%. The smaller sampling tubes are being developed at both sites.
W69-00729

DETERMINATION OF POROSITY AND PERMEABILITY OF SELECTED SANDSTONE AQUIFERS OF SOUTH DAKOTA,
South Dakota School of Mines and Technology, Rapid City.
John P. Gries, and David W. Niven.
Dep Geol Geologic Eng Rept, Feb 1967. 13 p, 4 fig, 1 tab, 5 ref, append. OWRR Project A-004-SDak.

Descriptors: *Porosity, *Permeability, *Confined water, Cores, South Dakota, Aquifers, *Sandstones, Sampling, Geology, Hydrogeology, Testing, Measuring instruments, Rock properties, Groundwater, Groundwater recharge.

Lower Cretaceous sandstones crop out continuously around the periphery of the Black Hills. These outcrops are believed to be the principal intake area for artesian water within these formations. Data on porosity and permeability were obtained from 376 cores cut by the investigators from outcrops along a 70 mi interval on the east flank of the Hills. Porosity and permeability were determined in the laboratory by means of a Ruska Porometer and a Ruska Permeameter. Permeability of Lakota Sandstone (202 cores) cut parallel to bedding ranged between 1.2 and 41,500 md, with a mean of 9115 md. Permeability perpendicular to bedding (35 samples) varied from 15.7 to 30,800 md, with a mean of 5683 md. Porosity of all 237 Lakota cores averaged 28.5%. Permeability of Fall River Sandstone (86) cores cut parallel to bedding ranged from 0 to 10,600 md, with a mean of 2052 md. Perpendicular to bedding (17 samples) ranged from 0.3 to 3622 md, with a mean of 793 md. Mean porosity of 103 Fall River cores was 23.9%. Mean values for 15 Newcastle Sandstone cores showed a permeability of 461 md, and a porosity of 19.6%. These outcrop figures are consistently greater than corresponding values reported from nearby deep oil and water tests.
W69-00734

OCCURRENCE OF NITRATE IN WELL WATERS,
Illinois Univ., Urbana.
T. E. Larson.
Water Resour Center, Proj 65-05G, June 1966. 15 p, 2 fig, 5 tab. OWRR Project A-005-Ill.

Descriptors: *Wells, *Nitrates, Chemical analysis, *Concentration, Deep wells, Shallow wells, Hazards, Livestock, Man, Farm wastes, Soil types, Field investigations, Illinois.

Purpose of this project was to study the occurrence of nitrate in well waters in Illinois by relating nitrate occurrence to well depth, to the source of the water, to the physiographic divisions of the state, and to the geographical location of the well. Selected locations within the state containing high nitrate concentrations were correlated with geologic information on soils and subsoils. The study shows that excessive concentrations of nitrate are more likely to be found in shallow wells than in deeper wells. Of the samples taken from shallow wells 23% contained 45 mg/1 or nitrate. Excessive concentrations of nitrate are more likely to be found in drift wells than in limestone or sandstone wells. High nitrate concentrations were well scattered throughout the state except for 3 areas. Well construction is an important factor in the nitrate content of well waters. Any construction that allows surface water or water from a shallow depth to enter the well is more likely to contain excessive nitrate concentrations. No attempt was made to correlate nitrate concentration with soil types or with proximity to common sources of nitrate in farm wells such as barnyards, feedlots, manure piles, and septic tank fields.
W69-00741

RECORDS OF WELLS, WATER LEVELS, AND CHEMICAL QUALITY OF WATER IN THE LOWER SANTIAM RIVER BASIN, MIDDLE WILLIAMETTE VALLEY, OREGON,
U. S. Geological Survey, Washington, D. C., Water Resources Division.
D. C. Helm.
Oregon State Eng Ground Water Rep No 13, May 1968. 186 p, 4 fig, 1 plate, 1 map, 4 tab, 8 ref.

Descriptors: *Data collections, *Hydrologic data, *Water wells, *Water levels, *Water quality, Oregon.
Identifiers: Santiam River Basin (Oregon).

Well records, water levels, and groundwater chemical analysis data are collected and compiled as part of a comprehensive hydrologic study of the Lower Santiam River Basin in the Middle Williamette Valley, Oregon. Water-level fluctuations are shown on hydrographs of 12 selected wells in the area. Records of 1,204 wells include 919 irrigation wells, 128 domestic wells, 53 industrial wells, 19 public supply wells, 10 institutional wells, 4 stock wells, 54 unused wells, 7 test wells, and 10 unclassified wells. Data for each well include type, use, year completed, depth, diameter, depth of casing, finish, depth to aquifer, aquifer thickness, character of aquifer, altitude and depth of water, pump, yield, drawdown, use, acres irrigated, and remarks. Drillers logs of 349 wells are compiled. Chemical analyses of water from 49 wells, 1 spring, and 5 rivers, and spectrographic analyses of water from 7 wells are reported. The standard analyses include silica, Fe, Mn, Ca, Mg, Na, K, bicarbonate, carbonate, sulfate, Cl, F, NITRATE, PHOSPHATE, B, As, TDS, hardness, pH, and color. Spectrographic analyses include Al, Be, Bi, Cd, Cr, Co, Cu, Ga, Ge, Fe, Pb, Mn, Mo, Ni, Ti, U, V, Zn, Beta activity, and Ra. (Knapp-USGS)
W69-00920

GROUND WATER RECHARGE AND ITS POTENTIAL,
Texas Technological College, Lubbock.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00928

ARTIFICIAL RECHARGE THROUGH AUGMENTED BANK STORAGE,
Princeton Univ., N. J., Civil Eng Dept.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00970

REMOVAL OF IRON AND MANGANESE FROM GROUND WATER,
Mississippi State Univ., State College, San. Eng. Dept.
Lloyd R. Robinson, Jr.
Prog Rep, Water Resour Res Inst, 1966. 29 p, 2 fig, 8 tab, 10 ref. OWRR Project A-003-Miss.

Descriptors: *Groundwater, *Iron, *Manganese, Aeration, Sedimentation, Filtration, Pilot plants, Chemical analysis, Water quality, Sewage treatment, Mississippi.

This paper is a progress report on research to determine factors involved in removal of iron and manganese from ground waters and to find ways of counteracting these interferences in the conventional treatment method of aeration, sedimentation, and filtration. The first phase has been to complete an initial screening and includes studies of available state records and contacts with local and state officials to locate problem spots in Mississippi. The second objective has been to construct and test pilot plant facilities to be used in making a detailed study of the problem of interferences with the removal of iron and manganese from ground water. The pilot plant has been so constructed that it can be used to study waters brought to, or synthesized in the laboratory, or taken to the field and operated at well-site. The final objective which has not been completed is to find a method satisfactory for analyzing large numbers of manganese samples collected during the latter phases of the study.
W69-00971

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INSTRUMENTATION FOR SEISMIC EXPLORATION FOR GROUND WATER IN HAWAII,
Hawaii Univ., Honolulu.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-00974

EFFECTS OF SOLUBLE ORGANICS ON FLOW THROUGH THIN CRACKS OF BASALTIC LAVA,
Hawaii Univ., Manoa.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-00979

SOME SEISMIC TECHNIQUES FOR MAPPING SMALL SCALE SHALLOW STRUCTURES,
Hawaii Univ., Manoa.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-00985

ON THE SIMILITUDE OF DISPERSION PHENOMENA IN HOMOGENEOUS AND ISTROPIC POROUS MEDIUMS,
Tahal, Water Planning for Israel Ltd., Tel Aviv.
Y. Bachmat.
Water Resources Res, Vol 3, No 4, pp 1079-1083, 1967. 5 p, 5 ref.

Descriptors: *Dispersion, *Solutes, *Porous media, *Model studies, *Hydraulic similitude, Analytical techniques, Groundwater, Groundwater movement, Darcys law, Laminar flow, Model Studies.
Identifiers: Peclet number.

A procedure of simulating, by means of a physical model, the dispersion of a solute in groundwater flowing through a homogeneous and isotropic aquifer is considered. Groundwater is a solution of variable density and viscosity owing to variations of solute concentration. The model has a very restricted application owing to the required simultaneous invariancy of four nondimensional criteria of similutude: a macroscopic Reynolds number, a macroscopic Peclet number, the criterion of geometrical similarity of the medium, and the criterion of physcochemical similarity of the solution. However, at certain conditions, which are common in practice, some of those criteria can be waived, and the model becomes a useful device for the solution of field problems. These conditions occur in the range of validity of Darcy's law (small Reynolds numbers), at relatively high Peclet numbers, and at very small variations of relative solute concentration (ideal solute). (Author)
W69-01042

A METHOD OF DETERMINING THE PERMEABILITY AND EFFECTIVE POROSITY OF UNCONFINED ANISOTROPIC AQUIFERS,
Technion Israel Institute of Technology, Haifa.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-01044

ANALYSIS OF NON LINEARITIES IN GROUND WATER HYDROLOGY: A HYBRID COMPUTER APPROACH,
California Univ., Los Angeles.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-01047

FACTORS AFFECTING GROUND-WATER RECHARGE IN THE MOSCOW BASIN, LATAH COUNTY, IDAHO,
Washington State Univ, Pullman.
Chang-lu Lin.
Pap, Dept of Geol, Sept 1967. 86 p, 31 fig, 7 tab, 39 ref. OWRR Project A-007-WASH.

Descriptors: *Groundwater basins, *Hydrogeology, Aquifers, Water table, Groundwater barriers, Groundwater movement, Idaho, Groundwater recharge, Natural recharge, Hydrologic cycle, Surface groundwater relationships, Geologic control.

The depleting ground-water reservoir reflected by long-term declines in the piezometric surface creates a critical problem in the Moscow basin. Results of climatological, hydrological, and geological studies indicate that low intensity of precipitation; (1) frozen ground; (2) high evaporation potential; (3) thickness, extent, and clay content of the Palouse loess and Latah Formation; (4) interflow zones; (5) fracture zones; and (6) the presence of ancient drainage channels are the primary factors affecting ground-water recharge in the basin. Fluorescent dye-dilution techniques have been used to detect stream losses near the margins of the plateau basalts. Results of these measurements verify other studies and indicate that this method is a sensitive tool in measuring the low flow of a stream. By applying this method, it can be shown that a portion of the surface flow joins the underflow in areas of low gradient and again rejoins the surface stream in reaches of steep gradient along Crumarine Creek. A portion of the underflow or component of surface flow eventually recharges the basin.
W69-01151

UNSTEADY UNCONFINED GROUNDWATER FLOW TOWARD A WELL,
Wisconsin Univ, Madison.
Willard A. Murray.
Pap, 1966. 19 p, 2 fig, 1 tab, 8 ref. OWRR Project A-005-WIS.

Descriptors: *Groundwater flow, *Wells, *Unsteady flow, Ground water, Computer programming, Aquifers, *Drawdown, *Water wells.
Identifiers: Pumping tests, Dupuit-Forchheimer idealiza.

The differential equation for unsteady unconfined radial flow to a well is solved by a numerical method on a digital computer. The application of the Dupuit-Forchheimer concept is the only simplifying assumption made. Analysis of results indicate that there is a substantial range of values for which the confined flow (Theis) solution is sufficiently accurate for use in problems involving unconfined aquifers. Graphical methods of solution are presented for determining aquifer characteristics and for predicting drawdown curves in unconfined aquifers.
W69-01153

GROUND-WATER HYDROLOGY OF THE MONOGAHELA RIVER BASIN IN WEST VIRGINIA,
U S Geological Survey.
Porter E. Ward, and Benton M. Wilmoth.
West Virginia Geol and Econ Surv, River Basin Bull 1, 54 p, 1968. 22 fig, 6 tab, 38 ref.

Descriptors: *Groundwater, *Water resources, *West Virginia, *Water yield, *Aquifers, Water quality, Water sources.
Identifiers: Monogahela River Basin (W. Va.).

Adequate supplies of groundwater are available in the Monogahela basin to meet present and future requirements. The best sources are wells in bedrock, particularly in sandstone. The most favorable areas are underlain by rocks of the Pottsville Group, Allegheny Group, Greenbrier Limestone, and the Pocono Formation. Yields of 50-350 gpm are common in most areas. The Dunkard Group yields only about 21 gpm; development of water supplies in its outcrop area is difficult, requiring intensive investigation and test drilling. Alluvium is too thin and areally restricted for large groundwater development. Water quality is generally good, with high iron, hardness, and hydrogen sulfide concentration in a few places. Some salty water is found below 100-300 ft in the western part of the basin. Some oilfield, municipal, household, and chemical pollution occurs in a few areas. Coal-mine acid pollution has a small effect generally, but in some populated areas it is a difficult problem. Descriptions of geologic units and their water-bearing properties are tabulated. Geology, water potential, and water quality are shown by maps. (Knapp-USGS)
W69-01179

RADIOMETRIC STUDIES OF THE FLORIDAN AQUIFER: PROJECT COMPLETION REPORT, (CHAP) B--U-234/U-238 DISEQUILIBRIUM AS AN AID TO HYDROLOGIC STUDY OF THE FLORIDAN AQUIFER,
Florida State University, Department of Geology, Tallahassee.
M. E. Kaufman, H. S. Rydell, and J. K. Osmond.
U S Office of Water Resources Research, Washington, D C, pp B1-B5, July 1968. 5 p, 1 fig. OWRR Project A-005-Fla.

Descriptors: *Uranium radioisotopes, *Tritium, *Tracers, *Water sources, *Karst, Movement, Water circulation, Radiochemical analysis, Florida.
Identifiers: Floridan aquifer.

Uranium disequilibrium studies of the waters of the Floridan aquifer in north Florida suggest the possibility of using the study of natural fractionation of uranium isotopes to aid in hydrologic investigations. Analysis of the relations between the isotopic distribution patterns and the hydrologic flow system indicates the following: (1) Artesian waters exhibiting large negative departures from equilibrium (U-234/U-238 ratios: 0.50 to 0.96) underlie the Woodville Karst Plain and parts of the sinkhole-riddled Tallahassee Hills, interpreted as areas of recharge, high permeability and rapid circulation of groundwater. To account for the low isotopic ratios observed in these waters, it is hypothesized that Pleistocene leaching occurred, resulting in preferential removal of U-234. (2) Artesian waters with U-234/U-238 ratios near equilibrium are associated with Gulf Trough, interpreted as an area of low permeability and restricted groundwater circulation, with little Pleistocene leaching. A hydrologic barrier preventing any significant present southeastward movement of groundwater across the Gulf Trough is suggested. A tritium study of the Floridan aquifer shows promising preliminary results but is as yet incomplete. (Author)
W69-01181

PHASE I TEST WELLS, WHITE SANDS MISSILE RANGE, DONA ANA COUNTY, NEW MEXICO,
U S Geol Surv, Albuquerque, N Mex.
Gene C. Doty.
U S Geol Surv open-file rep, 39 p, July 1968. 12 fig, 11 tab, 2 ref.

Descriptors: *Water supply, *Water wells, *Exploration, New Mexico, Hydrologic data, Aquifers, Chemical analysis, Data collections, Water yield, Logging (Recording).
Identifiers: White Sands Missile Range (New Mexico), Test holes.

To explore the water-producing potential of the south-central part of White Sands Missile Range, 5 test wells were drilled in 1966 and 1967. Samples were collected and described, electric logs were made, and water samples were collected and analyzed. Small-yield (5-10 gpm) wells can be drilled in the fractured igneous rocks near surface drainage channels. Storage is small and wells may not be dependable. Wells in an alluvial fan should yield several hundred gpm of potable water containing 200 ppm sulfate. Bolson deposits have transmissibilities of about 20,000 to 295,000 gpd per ft. Water quality varies markedly with depth; specific conductance at 352 ft was 1,490 micromhos and at 635 ft, 61,000 micromhos. Sample descriptions, drillers' records, and chemical analyses are tabulated. Copies of commerically

made electric and radiation logs are included. (Knapp-USGS)
W69-01186

THE APPLICABILITY OF DARCY'S LAW,
Purdue Univ, Lafayette, Indiana.
Dale Swartzendruber.
Soil Sci Soc of Amer Proc, Vol 32, No 1, pp 11-18, Jan-Feb 1968. 8 p, 6 fig, 1 tab, 36 ref, 1 append. OWRR Project A-004-Ind.

Descriptors: *Darcys law, *Kinetics, *Saturated flow, *Unsaturated flow, Velocity, Porous media, Clays, Diffusivity, Infiltration.
Identifiers: Nonproportional flow, Non-Darcian flow laws.

Deviations from Darcian proportionality between flow velocity v and hydraulic gradient i are considered in terms of a gradient-dependent hydraulic conductivity K (i)=v/i. Published data for saturated flow indicate measured variations in K (i) of 2- to 4-fold, with a potentiality for 5- to 15-fold variations inferred from fitted non-Darcian flow equations. Non-Darcian effects for 2-dimensional radial flow are also analyzed. The hydraulic head distribution is shifted from the Darcian-derived logarithmic pattern toward the characteristic linear distribution for 1-dimensional flow, and the amount of the shift is velocity dependent. This implies that the flow net changes with flow velocity, and that the high-gradient flow regions are more permeable than for Darcian flow. The soil-water diffusivity D for some unsaturated soils appears to be a gradient-dependent quantity. A maximum 8-fold variation in D is associated with a 40% discrepancy between experimental water-absorption rates and those calculated from proportional flow theory. Similarly, a 115% discrepancy in the rate of infiltration into a mixture of quartz sand and ground silica can be precisely accommodated with a non-Darcian infiltration equation derived by a simplified analysis. (Knapp-USGS)
W69-01188

GROUND-WATER EXPLORATION IN THE BOSQUE DEL APACHE GRANT, SOCORRO COUNTY, NEW MEXICO,
U S Geol Surv, Albuquerque, N Mex.
James B. Cooper.
U S Geol Surv open-file rep, 79 p, Aug 1968. 12 fig, 14 tab, 4 ref.

Descriptors: *Water supply, *Water wells, *Exploration, New Mexico, Hydrologic data, Aquifers, Chemical analysis, Data collections, Water yield.
Identifiers: White Sands Missile Range (New Mexico), Socorro County (New Mexico), Test holes.

Test drilling along the Rio Grande in the Bosque del Apache Grant in Socorro County, New Mexico shows that the area is hydrologically complex and that the quality of the groundwater varies from saline to fresh within short distances both laterally and vertically. Nearly all of the riverside land in the Grant is occupied by the migratory waterfowl refuge of the Bosque del Apache National Wildlife Refuge. Potable and near-potable water is obtained from 12 wells that tap sand and gravel, and the wells are capable of yielding 1,000 gal per minute or more. Stallion Range Center, a military installation on the White Sands Missile Range, about 15 miles east of the waterfowl refuge, needs about 100,000 gal per day of potable water, which is not known to be available at a location closer to the Center than the refuge area. Between 1963 and 1967, 7 test wells were drilled, and a suitable location for a supply well was found. The well would be about 250 ft deep and would tap a body of potable water that is about 100 ft in thickness. It is thought to underlie an area of at least 5 sq miles. Diagrammatic sections show the lateral and vertical relation of waters of different quality along the Rio Grande in a part of the Bosque del Apache Grant. Basic data in tables include records of 7 test wells, 12 high-yield supply wells, and 32 chemical analyses of groundwater from the wells. (Knapp-USGS)
W69-01189

EFFECT OF INCREASED PUMPING OF GROUND WATER IN THE FAIRFIELD-NEW BALTIMORE AREA, OHIO--A PREDICTION BY ANALOG-MODEL STUDY,
U S Geol Surv., Washington, D. C., Water Resources Div.
Andrew M. Spieker.
U S Geol Surv Prof Pap 605-C, pp C1-C34, 1968. 34 p, 23 fig, 1 tab, 15 ref.

Descriptors: *Water resources, *Groundwater, *Analog models, *Induced infiltration, *Alluvium, Pumping, Transmissivity, Safe yield, Drawdown, Ohio.
Identifiers: Great Miami River (Ohio), Cincinnati (Ohio), Fairfield (Ohio), Well interference.

Analysis of the groundwater availability of the Great Miami River Valley train aquifer near Fairfield, Ohio by electric analog model has been undertaken to study the hydrologic feasibility of Cincinnati's proposal to enlarge its well field. The 32 sq mi study area is underlain by a sand and gravel aquifer with a transmissibility of about 400,000 gpd per ft. The 2 mi wide aquifer is bounded on both sides by rock of low permeability. Total pumpage is 23 mgd. Recharge by induced stream infiltration is 325,000 gpd per acre of streambed. The model study indicated that a pumping rate of 40 mgd at the proposed well field can be sustained in addition to present pumping. Interference should not exceed 9 ft after 10 yr and total drawdown should not exceed 30 ft. A total pumping rate of 84 mgd from the aquifer is feasible. (Knapp-USGS)
W69-01192

2G. Water in Soils

HYDRODYNAMICS OF GEOPRESSURE IN THE NORTHERN GULF OF MEXICO BASIN,
U S Geological Survey, Baton Rouge, Louisiana.
Paul H. Jones.
Soc of Petrol Eng of AIME, No SPE 2207, 12 p, 1968. 2 tab, 39 ref.

Descriptors: *Osmotic pressure, *Infiltration, *Earth pressure, *Clays, *Pore pressure, Compaction.
Identifiers: Geopressure, Gulf Coast Area.

Pore water is trapped by rapid deposition of deltaic, inner neritic, and middle neritic sand and clay and by growth faulting in the Gulf marginal belt of subsidence. It is expelled rapidly with compaction and moves out through clay beds. Water expelled from the reservoir through clay beds is purified by hyperfiltration, and dissolved solids in remaining water are concentrated until osmotic pressure opposing the flow equals the lithostatic head differential. Consequent restriction of upward water loss increases reservoir temperature; this promotes early diagenesis of montmorillonite, which increases appreciably the volume of free pore water available to the reservoir. The molecular forces of osmotic pressure reduce the effective permeability of clay beds to zero, so that in many places geopressures have been preserved for millions of years. (Knapp-USGS)
W69-00923

THE ADAPTABILITY OF AN EXACT SOLUTION TO HORIZONTAL INFILTRATION,
Cornell University, Ithaca, New York.
Wilfried Brutsaert.
Water Resources Res, Vol 4, No 4, pp 785-789, Aug 1968. 5 p, 3 fig, 1 append, 12 ref.

Descriptors: *Infiltration, Porous media, Seepage, Soil, Moisture, Permeability, Darcys law, Capillary conductivity.
Identifiers: *Flow equations, Horizontal infiltration.

A mathematical solution is provided for the concentration-dependent diffusion equation. The equation is shown to be adaptable to the problem of horizontal infiltration, a phenomenon of one-dimensional flow in a partly saturated porous medium, by a suitable approximation of algebraic functions describing the moisture content capillary suction and the moisture content-capillary conductivity relationships. One of the theoretical results that compares favorably with published experimental data gives the cumulative infiltration as a simple power function. Specific equations are derived and calculations are plotted. (Llaverias-USGS)
W69-00927

BASIC WATER RESEARCH ON NEW ENGLAND SOILS,
Maine University, Orono.
R. V. Rourke, and C. Beek.
Project Completion report. Rep of Office of Water Resources Res, Maine Univ, 3 p and 98 p in attach, June 1968. OWRR Project A-001-Me.

Descriptors: *Data collections, *Soils, *Maine, *Hydraulic conductivity, Soil chemical properties, Soil physical properties, Soil water, Organic matter, Permeability, Retention, Soil water movement, Particle size, Soil density, Acidity, Alkalinity.
Identifiers: *Soil moisture reaction, *Percolation rate.

The physical hydrologic, and chemical characteristics of 8 Maine soils sampled at 5 locations each are collected and tabulated to aid in interpretation and use of soil maps for urban planning, industrial development, agricultural development, domestic waste disposal, and other uses. The characteristics measured and tabulated are organic carbon, moisture retention, water movement, particle size distribution, volume of coarse fragments, bulk density, soil reaction, exchangeable bases, and exchangeable acidity. Water retention was determined for several soil pressures and available moisture in each horizon was reported in inches of water per inch of soil. Saturated hydraulic conductivity was measured on many cores. The ability to receive septic sewage was evaluated by percolation rate tests. (Lang-USGS)
W69-00929

THE INFILTRATION OF IRRIGATION WATER INTO THE SOIL,
Mississippi State University, State College.
James B. Allen, William R. Fox, and Chi-Tong Chang.
Water Resources Res Inst, Completion Report. Miss State Univ Water Resources Res Inst, July 1968. 6 fig, 4 tab, 20 ref. 41 p, OWRR Project A-022-Miss.

Descriptors: *Irrigation, *Infiltration, *Irrigation efficiency, *Computer programs, *Mathematical models, Digital computers, Furrow irrigation, Mississippi.
Identifiers: *Antecedent moisture, Optimum efficiency.

The literature of soil water infiltration in furrow irrigation was reviewed and mathematical models of infiltration were established. The models were written in 4 FORTRAN IV programs for the IBM 360. A numerical example is presented to illustrate the effect of rate, duration, and interruption of inflow on irrigation efficiency. The results of the numerical example suggest that intermittent application of water can result in less runoff losses at some sacrifice in uniformity of application. (Knapp-USGS)
W69-00932

EXPERIMENTAL EVALUATION OF INFILTRATION EQUATIONS,
American Society of Agricultural Engineers, Utah State University, Logan.
R. W. Skaggs, F. F. Huggins, and E. J. Monke.
Paper presented at 1968 Ann. Meeting ASAE, Utah State Univ. Amer Soc of Agr Eng, Pap No 68-215, June 18-21, 1968. 6 fig, 3 tab, 24 ref, June 1968, 21 p, OWRR Project A-00-Ind.

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Descriptors: *Infiltration, *Equations, *Rainfall-runoff relationships, *Simulated rainfall, Model studies, Vegetation effects, Regression analysis.
Identifiers: Infiltration equations.

An analysis of infiltration equations proposed by Green and Ampt, Horton, Phillip, and Holtan was made on the basis of experimental data obtained in erosion studies with a plot sized rainfall simulator. An overload flow analysis was used to determine the infiltration - time relationship from the runoff hydrograph. Regression fits of the four equations to experimental data for 52 tests on 13 soils showed that all of the equations adequately described the infiltration rate - time relationship. Values obtained for the equation for each run analyzed are tabulated. (Author)
W69-00934

EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
Clemson University, Clemson, S C. Agricultural Engineering Department.
James T. Ligon.
Amer Society of Agr Eng 1968 Annu Meeting, Utah State Univ, Logan, June 18-21, 1968, Paper No 68-220, 1968. 28 p, 10 fig, 1 tab, 15 ref. OWRR Project A-003-SC.

Descriptors: *Soil moisture meters, *Gamma rays, *Research and development, *Instrumentation, Calibrations.
Identifiers: Gamma ray transmission measurements.

The use of the gamma-ray transmission technique for measuring soil moisture in situ is evaluated. The method has considerable potential, particularly near the soil surface and near significant interfaces. Drift of electronic equipment and the apparent temperature sensitivity of the portable equipment limit present field utility, but techniques to minimize errors are presented. Theory for the determination of moisture changes between observations without prior knowledge of soil density was developed. Field data showing amounts and distribution of soil moisture changes due to infiltration, drainage, and evapotranspiration were obtained in a field test using 5 sets of access tubes during the 1967 growing season at Clemson, S C. (Knapp-USGS)
W69-00936

SOIL MOISTURE AND SOIL TEMPERATURE CHANGES WITH THE USE OF BLACK VAPOR-BARRIER MULCH AND THEIR INFLUENCE ON PINEAPPLE,
Hawaii Univ., Manoa.
Paul C. Ekern.
Water Resour Res Center, Rep 3, Aug 1967. 7 p, 4 fig, 4 tab, 16 ref. OWRR Project A-008-Hi.

Descriptors: *Mulching, *Crop response, *Evapotranspiration, *Soil water, Micrometeorology, Moisture availability, *Lysimeters, Equipment, *Soil temperature, Consumptive use, Water utilization, Water requirements, Evaporation, Fine textured soil, Tensiometer.
Identifiers: *Pineapples.

As mulching practice in pineapple culture in Hawaii has developed over the last 50 yr, a number of functions have been assigned to the action of the mulch. This study gives primary consideration to effect of soil moisture and soil temperature changes upon pineapple growth. Soil moisture changes were determined from field samplings and lysimeter studies at Washiawa, Oahu. Changes in the soil moisture budget with the mulch were so slight that the variability of field sampling precluded assessment without excessive replication. Coefficients of variability for samples taken at the plant butt were 3 to 5% of a moisture constant (e.g., 15-bar point) for a soil series or within a single field. Moisture use, measured by semicontained hydraulic lysimeters, was reduced by the mulch when the soil was very wet but changed little when soil moisture ranged from field capacity (0.15-bar) to the 15-bar points. The mulch raised the average soil temperature about 1.6 C during winter. The measured 1/3 increase in plant growth was nearly identical with the increase calculated from growth-response of pineapple to temperature.
W69-00984

WATER VAPOR DIFFUSION IN RELATIVELY DRY SOIL: IV. TEMPERATURE AND PRESSURE EFFECTS ON SORPTION DIFFUSION COEFFICIENTS,
Dept of Agriculture, Tempe, Arizona, Water Conservation Laboratory.
Ray D. Jackson.
Soil Sci Soc of Amer, Proc, Vol 29, pp 144-148, 1965. 5 p, 6 fig.

Descriptors: *Arid lands, *Water vapor, Soils, Fine-textured soils, *Temperature, Gravimetric analysis, Gases, Liquids, *Diffusion, Monomolecular films, Movement, Thin films, *Water transfer, Equations, Pressure.
Identifiers: Coarse-textured soils, *Aridsoils.

Total diffusion coefficients measured at four pressures were used to calculate vapor and liquid diffusion coefficients for dry soils. Data indicated that the temperature dependence of water movement in thin films (water contents above a monolayer) was only slightly greater than the temperature dependence of bulk flow of water in soils. Water transfer in relatively dry soils occurred in both liquid and vapor phases. In coarse-textured soils vapor diffusion with the associated evaporation-condensation process was the predominant mechanism, while liquid diffusion was negligible. In fine-textured soils, diffusion in thin water films and along particle surfaces was appreciable. Determination of water vapor diffusion in relatively dry soil is important from the standpoint of the vast areas of dry soil that occur in arid regions of the world. (Blecker-Ariz)
W69-01018

A SENSOR FOR WATER FLUX IN SOIL. 'POINT SOURCE' INSTRUMENT,
Commonwealth Scientific and Industrial Research Organization. Div. of Land Research, Canberra (Australia).
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01050

INFILTRATION BENEATH A FOREST FLOOR,
Washington Univ, Seattle.
Robert G. LaRock.
Tech Rep 21, Dep Civ Eng, Feb 1967. 23 p, 10 fig, 1 tab, 9 ref. OWRR Project A-001-WASH.

Descriptors: Hydrology, *Infiltration, Percolation, *Soil moisture, Moisture content, Lysimeters, Moisture tension, Hysteresis, Rainfall, Measuring instruments, *Forests.

Using a tension lysimeter system, tensiometers and a soil moisture neutron probe, moisture characteristics of a glacial outwash soil were determined during periods of soil moisture flow resulting from rainfall. In the flow range from zero, with soil at field moisture capacity, to 0.2 in./hr a change of 3% was observed in the soil moisture, and a change of 25 cm in tension. At a depth of 16-in. lateral flow was found during periods of rapid soil moisture flow, in spite of the coarseness of soil texture. It is presumed that this lateral flow was due to the gradual increase in coarseness with depth in the top 2 ft of this soil. Hysteresis characteristics of the soil were determined at depths of 16 and 74 in. The increase in coarseness in the surface 2 ft partially inhibited unsaturated water percolation, causing a wetter-when-wetting moisture-tension hysteresis at the 16-in. depth. A textural boundary at the 14-in. depth of coarse over finer material caused no distinct hysteresis effect.
W69-01150

MECHANICS OF BANK SEEPAGE IN NATURAL STREAMS DURING FLOOD FLOWS,
Nebraska Univ, Lincoln.
Alexander R. Peters.
Water Resour Res Inst Rep, Jan 1968. 26 p, 13 fig, 7 ref. OWRR Project A-006-NEB.

Descriptors: *Banks, Piezometers, Permeability, Time, Soil moisture, Porous materials, *Bank storage, *Seepage, *Groundwater flow, Sands, Porosity, Hydrology, Laboratory tests, Fluid flow.
Identifiers: *Permeability coefficients, Storage coefficients, Darcys law, Transmissivity, Compressibility.

The mechanics of bank seepage have been investigated by studying the characteristics of oscillatory fluid motion in porous media. Of particular interest was the way fluid is stored and given up by the porous medium. The purpose of this theoretical and experimental program was to obtain a better understanding of flow phenomena inside the soil. The various parameters affecting permeability were considered in order to determine the amount of flow stored during 1 cycle of a stream oscillation. Experiments were conducted using a two-dimensional watersand reservoir with 3 kinds of sand and various amplitudes and periods of oscillation. The coefficients of permeability, storage, porosity, and compressibility were determined and were incorporated in the evaluation of the experimental data.
W69-01163

2H. Lakes

THE CONTINUOUS PLANKTON RECORDER--A REVIEW OF THE LITERATURE,
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-00740

INHERENT AND MAXIMUM MICROBIOLOGICAL ACTIVITY IN SMITH LAKE,
Alaska Univ., College.
S. Burton.
Inst Water Resour Rept, 1968. 8 p, 1 tab. OWRR Project A-004-Alas.

Descriptors: Nitrogen, Microorganisma, Arctic, Kinetics, Enzymes, *Azotobacter, Nitrogen cycles, Biological properties, Cold resistance, Limnology, Lakes, Aquatic environment, *Nitrogen fixing bacteria, Aerobic bacteria, *Aquatic bacteria.
Identifiers: Smith Lake, Alaska.

An examination of the microorganisms catalizing chemical changes in a sub-Arctic lake was made to augment current knowledge of the nutrient cycles in the near Arctic. Several unusual nitrogen fixing species using nitrogen 15 experiments were isolated. Their characteristics were such that they could not be placed in the genera Azatobacter or other known genera. A number of phychrophiles were also isolated and classified. Studies of the enzyme tryptophane synthetase were conducted to compare enzymatic activities of psychrophiles and organisms growing at more usual temperatures. No unusual kinetics were determined.
W69-00744

EYES ON THE VOLTA LAKE, GHANA,
California Institute of Technology, Pasadena.
Jefferey Ram.
New Sci, Vol 39, No 614, pp 540-541, Sept 12, 1968. 2 p, 1 map.

Descriptors: *Limnology, *Reservoir stages, *Succession, *Aquatic environment, Biological properties, Fish, Aquatic weeds, Chemical properties, Physical properties, Stratification.
Identifiers: Ghana, Volta River.

The changes in aquatic environment caused by filling a 3,200 sq mi lake on the Volta River in Ghana are being studied under the direction of the Volta Basin Research Project. Such studies are

vital for the development of water resources, fishing industry, and for weed control. The data which are being collected include commercial fish catch changes, insect population changes, weed growth, physical and chemical quality, and stratification of lake water. (Knapp-USGS)
W69-00931

THE ECOLOGICAL SIGNIFICANCE OF CELLULOLYTIC BACTERIA IN QUABBIN RESERVOIR,
Clark Univ., Worcester, Mass.
John T. Reynolds.
Proj Completion Rep, Jan 1968. 11 p. OWRR Project A-007-Mass.

Descriptors: *Ecology, Bacteria, Algae, Phytoplankton, *Lakes, *Cellulose, Distribution patterns, Membrane processes, Massachusetts.

Ecological significance of cellulolytic bacteria in a large reservoir in central Massachusetts was studied. Bacteria were enumerated using membrane filter techniques: cellulolytic forms were grown out on a modification of Sanborn's China blue-cellulose dextrin agar, and heterotrophs on a mineral salt-mud extract agar and on MPH agar. Suspended cellulose and hemicellulose were concentrated by filtration and estimated by spectrophotometric determinations after treatment with phenol and sulfuric acid. Algae were enumerated and typed using standard procedures, and estimates of the amounts of cellulose produced by the phytoplankton observed were made after determinations of the amounts of cellulose present in known concentrations of algae representative of the types found in the reservoir. Total numbers of bacteria varied between less than 1 per ml of sample to a high of 170 per ml of sample. Presumptive cellulolytic bacteria accounted for from less than 0.5 to 52% of the total bacterial populations measured in several different areas before, during and after an algal bloom. Numbers of presumptive cellulolytic bacteria appear to have no consistant relation with estimates of amounts of cellulose. Estimates of cellulose content of the water varied between 360 to 2750 micrograms per liter of sample.
W69-00976

A MOBILE LIMNOLOGICAL LABORATORY,
Minnesota Univ., Minneapolis, Limnological Res Ctr.
Robert O. Megard, and Joseph Shapiro.
J Limnol Oceanogr, Vol 11, No 3, pp 420-422, July 1966. 3 p, 5 fig. OWRR Project A-008-Minn.

Descriptors: *Limnology, Primary productivity, Chemical analysis, *Eutrophication, Data collections, Aquatic environment, Biomass, *Laboratory equipment.

In connection with the study of primary productivity in Minnesota lakes, a mobile limnological laboratory was constructed with most of the facilities of a modern, well-equipped permanent laboratory. The laboratory is self-contained and can be operated in the field for weeks or months. It is heated and insulated, and has several alternate water and electrical supplies. Standard titrimetric and colorimetric analyses, as well as more sophisticated instrumental analyses, can be performed in field under conditions that compare favorably with conditions in a permanent laboratory. Storage space for limnological equipment and for sediment-coring apparatus is ample and easily accessible.
W69-00993

COMPUTATION OF THE COMPONENTS OF THE THERMAL BALANCE OF PLANNED RESERVOIRS,
L. V. Nesina.
Soviet Hydrol: Selec Pap, No 2, pp 183-189, 1967. 7 p, 4 fig, 2 tab, 13 ref. Translated from Trudy GGO, Main Geophys Observ, No 206, pp 31-37, 1967.

Descriptors: *Heat budget, *Reservoirs, Air temperature, Water temperature, Humidity, Wind velocity, Depth.
Identifiers: USSR, Reservoir thermal budgets.

A method of determining the components of the thermal balance of planned reservoirs is examined. The method is based on computations of the water surface temperature, air temperature and humidity, and wind velocity over the surface of the reservoir. Examples of the computation of the components of the thermal balance are given for reservoirs of various dimensions and depths, and the results of the computations are analyzed. (Author)
W69-01035

SURFACE CHLORIDE DISTRIBUTION IN MAINE LAKES,
Maine Dept. of Inland Fish and Game, Dry Mills Hatchery, Gray.
Donald F. Mairs.
Water Resources Res, Vol 3, No 4, pp 1090-1092, 1967. 3 p, 1 fig, 7 ref.

Descriptors: *Water quality, *Lakes, *Maine, Chlorides.

Chloride analyses on surface water samples collected from 126 Maine lakes demonstrate the generally acknowledged trend toward decreasing chlorides as distance from the coast increases. Some anomalous values are reported, about 1/2 of which are in hard water areas. The possibility is raised that highway salting in winter may affect surface chloride levels in Maine lakes. (Knapp-USGS)
W69-01051

EQUILIBRIUM SURFACE WATER TEMPERATURES,
Colorado State Univ., Fort Collins.
James LaVerne Hatheway.
M S Thesis, Colo State Univ, Fort Collins, 55 p, June 1968. 3 fig, 16 tab, 1 append, 54 ref. OWRR-A-006-Colo.

Descriptors: *Water temperature, *Heat transfer, Climatology, Heat budget, Evaporation, Convection, Radiation, Thermal pollution.
Identifiers: Surface water temperature.

A method of predicting the equilibrium surface water temperature of rivers and lakes under natural or thermally polluted conditions was developed. Heat transfer by evaporation, convection, radiation, and solar radiation are included in the development. A mass transfer coefficient was calculated using known mean monthly values for all parameters, obtained from a study of several rivers and a lake. The mass transfer coefficient was correlated empirically with mean monthly wind velocity, and appears to be a function only of wind velocity. Formulas are presented for trial and error calculation of surface water temperatures. (Knapp-USGS)
W69-01058

STRONTIUM ISOTOPE COMPOSITION AND TRACE ELEMENT CONCENTRATIONS IN LAKE HURON AND ITS PRINCIPAL TRIBUTARIES.
Ohio State Univ, Columbus.
Gunter Faure, Lois M. Jones, and Rene Eastin.
Rep 2, Dept of Geol, Aug 1967. 109 p, 21 fig, 20 tab, 28 ref. OWRR Project B-004-Ohio.

Descriptors: Geochemistry, Bedrock, Sedimentary petrology, Great Lakes, Mineralogy, Radioisotopes, Strontium radioisotopes, Lake Huron, Trace elements.
Identifiers: Bedrock composition.

Concentrations of the major cations: Na, K, Ca, and Mg and Sr were determined for 64 samples of surface water from Lake Huron and for 17 of its major tributary rivers. Isotopic compositions of strontium were measured for 30 samples of lake water and for 13 of tributary rivers. Concentrations of dissolved iron and total phosphorus were determined for a small suite of lake and river water. The data documents important differences in the chemical composition of water discharged into Lake Huron by Lake Superior, Lake Michigan and tributary rivers. These differences are related to differences in the chemical and mineralogical composition of the bedrock underlying the Great Lakes drainage basin. The strontium contributed to Lake Huron by water draining the Canadian Shield along its northern shore is enriched in radiogenic strontium 87. The average strontium 87/strontium 86 ratio is 0.718. The rivers draining sedimentary rocks of Michigan and SW Ontario contribute strontium whose isotope composition is similar to that in the modern oceans. A geochemical model is presented representing the chemical composition of water in Lake Huron.
W69-01139

THE KEWEENAW CURRENT, A REGULAR FEATURE OF SUMMER CIRCULATION OF LAKE SUPERIOR,
Wisconsin Univ, Madison.
Robert A. Ragotzkie.
Tech Rep 29, Univ Wisc, Aug 1966. 30 p, 18 fig, 2 tab, 9 ref, disc. OWRR Project A-004-WIS.

Descriptors: Bathythermographs, Distribution patterns, Isotherms, *Remote sensing, Current (Water), *Infrared radiation, Depth, Water temperature, Cross-sections, Thermocline, Circulation, Great Lakes, Lake Superior.
Identifiers: Keweenaw current, Lake currents, Keweenaw Peninsula (Mich.).

Infrared radiometer surveys of Lake Superior during the summer of 1964 and 1965 have shown that a band of warm water separated by a sharp thermal gradient appears along the north coast of the Keweenaw Peninsula in late June and persists at least into August. The subsurface thermal structure in this region indicates a steep slope of the geodynamic surface with the pressure gradient directed offshore. Calculation of current velocity based on the geodynamic slopes gives velocities up to one knot. Direct observations confirm the existence of this current both with regard to location and estimated velocity. The current, for which the name 'Keweenaw Current' is suggested, flows northeastward along the north coast of the Keweenaw Peninsula. It appears to be a boundary current and is probably maintained by the piling up of warm water along the south side of the lake by Ekman transport. It is shown that although the 'thermal bar' effect may exist in early June, this phenomenon does not provide an explanation for the temperature and circulation pattern observed later in the season. Analysis of infrared radiometer data at intersections of flight tracks on a single day gave diurnal heating rates of 0.21 to 0.27 deg C per hr. (Ragotzkie-Wisc)
W69-01152

2I. Water in Plants

THE ANALYSIS OF THE UPTAKE OF WATER BY PLANT ROOT SYSTEMS,
Illinois Univ., Urbana, Agronomy Dept.
A. Klute.
Water Resources Center, Project 65-03G, Aug 1966. 38 p, 18 fig, 7 ref. OWRR Project A-003-Ill.

Descriptors: Analysis, *Plant (Botany), Theory, Water table, *Soil moisture, Water, Models, *Plants.
Identifiers: *Plant-water physics.

The flow equation for water in unsaturated soil may be written to include a source term which can be used to represent the uptake of water by roots of plants. The roots are considered to be distributed in the soil in a continuous manner and the use of water by roots is represented as a negative source. The objective of the research work described in this paper was to obtain solutions of the flow equation for soil water for various boundary conditions and to investigate the effect of the source term on

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the flow patterns. The choice of the source function was studied. Experiments were planned and started to obtain data for verifying the predictions made from the flow theory and to aid in the development of a model for the source function.
W69-00973

THE MECHANICS OF FLUID TRANSPORT IN VEGETATION,
Massachusetts Univ., Amherst.
Denton B. Harris.
Proj Completion Rep, Feb 1968. 11 p, 3 fig, 2 tab, 10 ref, append. OWRR Project A-017-Mass.

Descriptors: Plants, *Flow, Pressure, Transpiration, Trees, Electric fields, Permeability, *Capillary action, Vegetation.

The cohesion theory of sap flow in vascular plants has been tested. Measurements of flow as a function of pressure deop indicate excessive negative pressure would be required for corollation between expiration rates and permeability in native species. Testing disproved diurnal variations in transpiring trees. Careful calibration indicates that measuring apparatus undergoes greater dilatation due to thermal change than does vegetation due to expiration. A search has been conducted for corollation between mass flow in vegetation and electric field potential. It has been shown that high intensity electric fields do have an effect on expiration rates in tomato plants. It has also been demonstrated that pressure induced flow in vascular plants produces an electric potential gradient. These results indicate atmospheric potential and/or biochemical potentials within the plant, may account for the driving forces for sap flow in vegetation. Further research should include microelectrometric surveys of living plant tissue. Gravimetric studies of expiration in electric fields should be undertaken at field intensities of between 200 and 500 volts per meter.
W69-01002

GROWTH AND YIELD OF SAGEBRUSHGRASS VEGETATION IN RELATION TO PRECIPITATION AND TEMPERATURE,
Forest Service, Washington, D. C., Div. of Watershed, Recreation and Range Res.
J. P. Blaisdell.
Proc 9th Int Grassland Congress, Vol 1, pp 465-468, 1966. 4 p, 4 tab.

Descriptors: Arid climates, Sagebrush, *Precipitation (Atmospheric), *Temperature, Productivity, Range grasses, *Correlation analysis, *Weight, *Plant growth, Soil moisture, Climatic data, Growth rates, Crop production, Plant populations, Seasonal.
Identifiers: *Herbage.

The study was concerned with the growth of rangeplants, their year-to-year variations and the extent to which these variations are related to precipitation and temperature on the arid Upper Snake River Plains of Idaho. Correlation analysis was used to relate precipitation and temperature to herbage production. Correlations were based on data for 13 years. Herbage weight was fairly well correlated with precipitation of the 9 month period immediately preceeding the growing season. Correlation coefficients between weight and annual precipitation for the period July 1 to June 30 were generally lower. Most of the plant growth in the locality was completed prior to June and the normal abundant precipitation during that month had little effect on current production. Precipitation during the growing season was rarely great enough to overcome a marked deficiency in soil moisture at planting time. (Blecker-Ariz)
W69-01008

DROUTH TOLERANCE EVALUATION AMONG RANGE GRASS GENERA, SPECIES, AND ACCESSIONS OF THREE SPECIES USING PROGRAM-CONTROLLED ENVIRONMENT,
Agricultural Research Service, Tucson. Crops Research Div.
L. N. Wright.
In affiliation with Arizona Univ, Tucson, Dept of Agronomy. Proc 9th International Grassland Congress, Vol 1, pp 165-169, 1966. 5 p, 1 fig, 3 tab.

Descriptors: *Drought tolerance, *Arid climates, Ranges, *Grasses, Germination, *Drought resistance, Seeds, Plant growth, Variability, *Plant breeding, Growth chambers.
Identifiers: *Seedlings, Survival, Reseeding, *Controlled environment.

A plant growth chamber was used to evaluate the six species, 43 accessions of blue panicgrass, 16 accessions of Boer lovegrass and 22 accessions of Eragrostis spp. for seedling drouth tolerance. Seedling survival data showed differences among accessions which reflect seedling drouth tolerance variability within a species, and further isolation of seedling drouth-tolerant plants within species would be expected. Results suggest that artificial seedling drouth tests can be used to isolate superior drouth-tolerant geno-types and in conjunction with other appropriate plant breeding techniques, to develop improved drouth-tolerant varieties. (Blecker-Ariz)
W69-01010

CONTRASTS AMONG CALANOID COPEPODS FROM PERMANENT AND TEMPORARY PONDS IN ARIZONA,
Ariz. State Univ., Tempe. Dept. of Zoology.
Gerald A. Cole.
Am. Midland Naturalist. Vol 76, No 2, pp 351-368. Oct 1966. 18 p, 5 fig, 4 tab, 38 ref.

Descriptors: *Ponds, *Arizona, *Copepods, Plankton, Aquatic animals, *Ecotypes, Clutch, Eggs, Life cycles, Wet seasons.
Identifiers: Temporary ponds, Permanent ponds.

Thirty-seven samples of plankton from Arizona ponds contained calanoid copepods. Eighteen of these were classified as temporary, the remainder permanent habitats. In order of predominance, the species were Diaptomus albuquerquensis; D. sicilloides; D. clavipes; D. novamexicanus; D. sanguineus and D. nudus. The three predominating species were found in both waters, D. nudus occurred in one permanent and the remainder were found in temporary sites. Clutch sizes and cephalothorax lengths were greater in temporary ponds and there was a correlation between female length and number of eggs per clutch. (Affleck-Ariz)
W69-01025

SNOW CATCH BY CONIFER CROWNS,
Washington State Univ., Pullman, and Forest Sci Lab, Moscow, Idaho.
Donald R. Satterlund, and Harold F. Haupt.
Water Resources Res, Vol 3, No 4, pp 1035-1039, 1967. 5 p, 2 fig, 3 tab, 7 ref.

Descriptors: *Interception, *Conifers, *Snow, Idaho.
Identifiers: Autocatakinetic growth.

Study of interception storage of snow by 2 species of sapling conifers in northern Idaho revealed that cumulative snow catch follows the Law of autocatakinetic growth, or growth which is increased by the results of previous growth and would continue at an increasing rate without constraint. The ability of tree limbs to bear snow is the constraint of the system, and up to that point growth rate increases because snow bridges gaps in the foliage and constantly increases snowholding platform area. Interception storage followed predictions in 5 storms which began with trees bare and in 2 in which snow fell on trees already holding snow. In no storms was there marked deviation from the autocatakinetic law. (Knapp-USGS)
W69-01049

STUDIES OF CONSUMPTIVE USE OF WATER BY PHREATOPHYTES AND HYDROPHYTES NEAR YUMA, ARIZONA,
U S Geological Survey.
Charles C. McDonald, and Gilbert H. Hughes.
U S Geol Surv Prof Pap 486-F, pp F1-F24, 1968. 24 p, 17 fig, 12 tab, 11 ref.

Descriptors: *Phreatophytes, *Consumptive use, *Evapotranspiration, Water table, Arizona, Bermudagrass.
Identifiers: Arrowweed, Quailbrush, Saltbrush.

Studies of the transpiration of several species of flood-plain vegetation, and evaporation from water surfaces and bare soil were carries out near Yuma, Ariz, during a 6-yr period, 1961-66. Arrowweed, fourwing saltbrush, quailbrush, and bermuda grass were grown under controlled conditions in 1,000 sq ft tanks; cattail was grown in 100 sq ft tanks. Evaporation from water surfaces was measured by 2 standard U S Weather Bureau Class 'A' pans and by a 10 ft sq ground-level tank. The immediate area had a moderately dense cover of preponderantly arrowweed, and the environment was principally desert, with high temperatures, low humidity, and a long growing season. Rates of evaporation and transpiration for this area are among the highest in the U S. Annual consumptive use increased with the volume of vegetation, but the consumptive use per unit volume decreased as the plants approached maturity. Depth to the water table strongly influenced evaporation from bare soil; for water table depths of 2.-4.0 ft, evaporation varied from 3 to 20 in. yearly. Arrowweed (Plichea Sericca) used an average of 96 in. of water per yr, quailbrush (Atriplex lentiformis) 44 in., saltbrush (Atriplex canescens), 38 in., and bermuda grass (Cynodon dactylon) used 73 in. (Knapp-USGS)
W69-01178

2J. Erosion and Sedimentation

PLANFORM ANALYSIS OF MEANDERING RIVERS,
Purdue University, Lafayette, Indiana.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00917

THE USE OF STOCHASTIC MODELS IN STUDIES OF ALLUVIAL CHANNEL PROCESSES,
U S Geological Survey, Fort Collins, Colo.
Carl F. Nordin, and Everett V. Richardson.
Int Ass for Hydraul Res 12th Cong Proc, Fort Collins, Colo, Sept 6-14, 1967, pp 96-102, 1967. 7 p, 3 fig.

Descriptors: *Statistical models, *Stochastic processes, *Markov processes, *Alluvial channels, Meanders, Sediment transport, River Systems.
Identifiers: Stochastic models, Poisson processes, Random walk, Branching processes.

Stochastic models can be used to describe either details of sediment transport phenomena or more general aspects of river channel morphology. The compound Poisson process and the random walk serve as models for the dispersion of sediment particles, and a linear second-order Markov process gives the essential statistical properties of the profile of a dune-covered bed. Branching processes and the theory of most frequent random walks find application as models for river networks and river meandering. For simple cases, models describing transport phenomena could be combined with the models of channel morphology to produce a more complete picture of alluvial channel processes. (Author)
W69-00937

THE SEDIMENT YIELD OF MAJOR RIVERS OF THE WORLD,
U S Department of Agriculture, Hyattsville, Maryland, Soil Conservation Service.
John N. Holeman.

Vater Resources Res, Vol 4, No 4, pp 737-747, ug 1968. 11 p, 7 tab, 30 ref.

)escriptors: *Sediment yield, *Erosion, *Runoff, Sediments, Rivers, Earth-water interfaces, Sedientation rates, Oceans.
dentifiers: *World rivers, *Water-borne sedients.

he measured and estimated sediment yield of the ajor world rivers are summarized, according to ontinents, drainage area, tons of sediment transorted, and water discharge data. Africa, Europe, nd Australia appear very low in sediment yield nd average 70, 90, and 115 tons per sq mi each ear, respectively. South America is low with 160 ons per sq mi; North America is moderate, with a alue of 245. Asia is the high producer of sediment, ith 1,530 tons/sq mi, which is equivalent to 80% f the sediment reaching the oceans yearly. These abulated data pertain to more than one-third of he land contributing water-borne sediment to the eas and, if representative, indicate an annual orld sediment yield of 20 billion tons (20 x 10 to he 9th power). (Llaverias-USGS)
V69-00941

RATE OF SOLUTION OF LIMESTONE IN THE KARST TERRANE OF FLORIDA,
lorida Univ., Gainesville.
I. K. Brooks.
Vater Resour Res Tech Completion Rep, Sept 967. 16 p, 2 fig, 23 ref. OWRR Project A-004-Fla.

)escriptors: Aerial photography, Aquifers, Cavies, Erosion, Water quality, Permeability, Porosity, Vater storage, *Stream erosion, Water table, Ruoff, *Sinkholes.
dentifiers: Artesian system, Caverns, *Karst terane.

)ata are presented and examples cited to explain he rate and pattern of development of the solution eatures in the karst terrane of Florida. The overall ate of erosion is 1.5 in. per 1000 yr; the rate varies onsiderably depending upon the quantity and omposition of the runoff influx. The early stages f the cycle have developed under artesian condiions with limited entry of surface water. Relatively ow primary porosity and permeability have esulted in the circulation and solution being fracure controlled. Subsequent development and hanneling of surface runoff into the aquifer results n solution of deep sinkholes, extensive caverns and he development of lake basins and prairies. Circuation of the nearly saturated water through the ock from pore to pore away from the solution avities has resulted in high secondary porosity and ermeability. In the open limestone plain under vater table conditions solution is concentrated in he upper phreatic zone but not because of shallow ines of flow. With this theoretical model of the levelopment of the porosity, permeability, and avities in the Floridan aquifer the fracture traces evident on aerial photographs can be used to obtain he quantity and quality of water desired.
W69-00997

SEDIMENT SAMPLING: INSTRUMENTATION AND TECHNIQUES,
Dept. of Agriculture, Oxford, Miss., Sedimentation Laboratory.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01015

COMPUTATION OF THE GREATEST POSSIBLE DEPTH OF CHANNEL DEGRADATION,
State Hydrological Institute, USSR.
N. S. Znamenskaya.
Soviet Hydrol: Selec Pap, No 2, pp 199-203, 1967. 5 p, 2 fig, 1 tab, 3 ref. Translation from Meteorologiya i gidrologiya, No 4, pp 80-84, 1967.

Descriptors: *Scour, *Stream erosion, *Forecasting, River beds, Dunes, Sand bars, Sand waves, Meanders.
Identifiers: USSR, Volga River, Amu Darya River, Syr-Darya River, Polomet' River.

A method is proposed for computing maximum expected scour at proposed engineering works in channels with dune-form beds. The height of a dune is a function of the ratio of scour to nonscour velocity and of stream depth. To verify the proposed relationship, computations were made and compared with measured depth of scour on the Volga, Amu Darya, Syr-Darya, and Polomet' rivers. In twenty-one comparisons, computations and measurements were within computed probability limits of depth of 10-1%. (Knapp-USGS)
W69-01033

DISCHARGE OF SUSPENDED SEDIMENTS AS A FUNCTION OF HYDROLOGIC CHARACTERISTICS,
N. N. Bobrovitskaya.
Soviet Hydrol: Selec Pap, No 2, pp 173-183, 1967. 11 p, 5 fig, 5 tab, 9 ref. Translation from Trudy GGI, No 141, pp 107-120, 1967.

Descriptors: *Sediment discharge, *Rivers, *Floods, Discharge (Water), Peak discharge, Hydrographs.
Identifiers: USSR, Polomet River, Flood Rise-sediment discharge relationships.

Mean annual suspended sediment discharge of the Polomet and other USSR rivers was investigated as a function of hydrologic characteristics, particularly of the rise of spring flood water. No unique relation between water discharge and sediment discharge was found. In most but not all stretches of the river sediment discharge was larger with rising than with falling water. The rate of rise of flood waters correlated strongly with sediment discharge, however. On a plot of sediment discharge against rate of floodwater rise the scatter was less than 30% all years except 1964, when it was 37%. Other rivers show generally similar relationships. (Knapp-USGS)
W69-01036

SPECIFIC DISCHARGE OF ENTRAINED SEDIMENTS,
K. I. Rossinskiy.
Soviet Hydrol: Selec Pap, No 2, pp 152-158, 1967. 7 p, 2 fig. Translation from Trudy GGI, No 141, pp 35-42, 1967.

Descriptors: *Sediment discharge, *Bed load, *Unsteady flow, Open channel flow, Velocity, Particle size, Particle shape, Roughness (Hydraulic), Probability.
Identifiers: USSR, Pulsating flow.

A formula is proposed for computing the discharge of bed load sediments under the influence of velocity pulsations. Discharge is a function of compactness of particle motion, defined as the ratio of instantaneous volume of moving particles to total volume of the layer in which motion occurs. Compactness is determined by particle shape, the degree to which the bottom surface is shielded from scour by roughness elements, and the proportion of time the pulsating flow exceeds threshold particle-displacement velocity. In the analysis presented, shape and roughness are treated as constant. The equations relate discharge to velocity for each particle size present in the sediment by use of Gaussian probability curves to estimate the part of the pulsating flow exceeding scour threshold. (Knapp-USGS)
W69-01037

A THERMODYNAMIC ANALOGY FOR MEANDER SYSTEMS,
U S Geological Survey and Illinois Univ., Urbana.
A. E. Scheidegger.
Water Resources Res, Vol 3, No 4, pp 1041-1046, 1967. 6 p, 1 fig, 7 ref.

Descriptors: *Meanders, *Thermodynamic behavior, Statistical methods, Stochastic processes.
Identifiers: Thermodynamic analogy.

A thermodynamic analogy for meander systems can be set up such that analogs of temperature, entropy, and free energy can be defined, based on the statistical aspects of meander formation. Meanders seem to be related to the fact that a river has a finite probability to deviate from a straight course, and the probability distribution of deviation is Gaussian. There is a great similarity between this statistical problem and an analogous one in the kinetic theory of gases. Solutions to gas dynamics problems can be used in solving problems of development of meander systems. (Knapp-USGS)
W69-01048

INSECTICIDE ADSORPTION BY LAKE SEDIMENTS AS A FACTOR CONTROLLING INSECTICIDE ACCUMULATION IN LAKES,
Wisconsin Univ, Madison, Wisconsin.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-01154

SPECULATIONS CONCERNING PALEOHYDROLOGIC CONTROLS OF TERRESTRIAL SEDIMENTATION,
Colorado State Univ, Fort Collins, and U. S. Geological Surv, Washington, D. C.
S. A. Schumm.
Geol Society of Amer Bull, Vol 79, No 11, pp 1573-1588, Nov 1968. 20 p, 1 tab, 4 fig, 5 photo, 63 ref.

Descriptors: *Paleohydrology, *Hydrologic data, *Sedimentation rates, *Vegetation effects, Cenozoic Era, Sediment load, Channel morphology, Climatology.
Identifiers: *Terrestrial sedimentation, Phytologic data, Speculations.

A variety of hydrologic data and geomorphic observations were reviewed and used to speculate on the changes in the hydrologic cycle, river morphology, and fluvial sedimentary deposits during geologic time. Prior to significant vegetal cover, denudation and runoff rates were high and floods were large, and coarse sediments were spread as sheets over piedmont areas. With appearance of terrestrial vegetation and its colonization of the land surface, erosion rates decreased, as did runoff and flood peaks. Alluvial deposits became stabilized, but large floods caused periodic flushing of sediment from the system, thereby creating sedimentary cycles of deposits. The influence of climate change on volume and type of sediment moved from an erosional system became more pronounced as the effect of vegetation on the hydrologic cycle increased. As grasses developed during the Cenozoic Era the relations between climate, vegetation, erosion, and runoff became like today except for man's influence. Diagrams, graphs, and photos show hypothetical series of rainfall-runoff relationships during geologic time and bed-load and suspended-load stream channels of today. (Lang-USGS)
W69-01164

OCCURRENCE OF POOLS AND RIFFLES: AN ELEMENT IN THE QUASI-EQUILIBRIUM STATE OF RIVER CHANNELS,
Western Ontario Univ, London, Ontario, Canada.
Raymond K. Dolling.
Ontario Geogr, No 2, pp 3-11, 1968. 9 p, 2 fig, 2 plate, 3 tab, 7 ref.

Descriptors: *Streambeds, *Channel morphology, *Energy losses, *Statistical methods, *Regression analysis, Mannings equation, Depth, Roughness (Hydraulic), Velocity.
Identifiers: Pools and riffles.

A sequence of 15 pools and 15 riffles on Bronte Creek, Ontario, was studied to determine objective criteria to be used to distinguish pools and riffles and to determine their relation to energy distribution in the stream. The dimensionless

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velocity/depth ratio was chosen for use in the analysis because it is easily determined and it may easily be compared with values from other areas. It is subjectively apparent that low values of velocity/depth correlate with pools, and high values with riffles. A multiple regression analysis was made with velocity/depth as the dependent variable and slope/width and roughness as independent variables. The predictive value of the independent variables is 96%. The model fails to explain the relation of power expenditure in pools and riffles because it does not include water surface slope as a variable. To explain scour in pools it is subjectively evident that high flows, slope in pools must be greater than over riffles, so that equal energy is expended in each. (Knapp-USGS)
W69-01166

PRELIMINARY APPRAISAL OF STREAM SEDIMENTATION IN THE SUSQUEHANNA RIVER BASIN,
U S Geol Surv, WRD.
K. F. Williams, and J. R. George.
U S Geol Surv open-file rep, 49 p, Mar 1968. 11 fig, 6 tab, 31 ref.

Descriptors: *Sedimentation, *Reservoir silting, *Pennsylvania, Particle size, Sediment yield, Provenance, Mining, Farms.
Identifiers: Susquehanna River Basin.

Analyses of stream-sediment discharge measurements collected in the Susquehanna River basin up to October 1965 are used to describe the sediment yield of major tributaries. The Susquehanna carries 110 tons of sediment per sq mi of its drainage basin, ranging from 30-950 tons per sq mi in glaciated terrain and from 37-500 in unglaciated areas, with the highest yields from farmland in the Piedmont. Coal mining contributes sediment, but apparently no more than other cleared-land activities. Available data suggest that forest cover and overland runoff are the 2 principal factors that determine stream sedimentation rates throughout most of the basin. Knowledge of these 2 variables permits prediction of the annual sediment yield of basins in unglaciated terrain with an average error of about 25%. The sediment consists of 15% sand, 55% silt, and 30% clay. Piedmont streams carry more silt and clay than other streams in the basin. Reservoir silting is slight, but small reservoirs and recreation pools in larger reservoirs have some problems. Reservoir sedimentation surveys suggest a long-term downward trend in sedimentation rates since the 1930's. (Knapp-USGS)
W69-01190

2K. Chemical Processes

THE ION-EXCHANGE REACTIONS OF RADIOACTIVE IONS WITH SOILS AND EFFECTS OF ORGANIC COMPOUNDS,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-00726

CHEMICAL CHARACTER OF GROUND AND SURFACE WATERS IN RELATION TO SOIL WEATHERING PROCESSES,
New Hampshire University, Durham.
A. B. Prince, and H. Chien.
Project Completion Report. Report, Water Resource Res Center, N H Univ, Durham, 7 p text, 31 tab, 8 append. June 1968, 46 p, OWRR Project A-002-NH.

Descriptors: *Soil water, *Water chemistry, *Weathering, Leaching, Iron, Movement, New Hampshire.

Study of the soil water chemistry of a wooded site on the bank of Oyster River, New Hampshire, showed that dissolved solids are removed from the area at a maximum rate of about 140 tons per year per sq mi with approximately 120 tons from rock dissolution and 20 tons from rainfall and human sources. The relationship of silica to discharge suggests that 10-12 ppm silica may be a criterion for determining when all streams flow is from ground water. Where the soil was well-drained and aerated, the contribution of iron to the river water was small. Where the soil was very poorly drained and aerated, the concentration of iron in the soil water was high and probably was a major source of the iron in the river water. As flow from the wetland increases, iron and organic content increase but pH and alkalinity decrease. Studies of the movement of iron in well-drained Melrose soil showed that the amount of iron in solution was relatively low and diminished with depth, resulting in a net accumulation of iron at an average depth of 2 in.-8 in., and iron released to the soil solution at or near the soil surface did not penetrate the top 16 in. of soil over an 84-day period under conditions of relatively high precipitation (10.32 in.), warm temperature (70-80 F) and absence of large channels. (Knapp-USGS)
W69-00925

SOLUBILITY EQUILIBRIA INVOLVING METAL OXIDES AND CORRESPONDING AQUEOUS METAL PERCHLORATES,
North Carolina Univ., Chapel Hill, Chem Dept.
Forrest C. Hentz, Jr.
Water Resour Res Inst Rep 7, 1967. 16 p, 2 fig, 3 tab, 26 ref. OWRR Project A-005-NC.

Descriptors: Equilibrium, *Turbidity, *Titanium, Supersaturation, *Chemical precipitation, *Polymers.
Identifiers: *Hydrolytic polymers, Light-scattering method, Polymerization.

Light-scattering measurements at 25 deg C on Th (NO sub 3) sub 4 solutions containing 0, 1, 2, and 3 bound hydroxyls per thorium atom hydroxyl number have been made over the range 0.01-0.10M in total Th with each solution also 1.0M in NaNO sub 3. The weight-average degree of polymerization calculated for each stage of hydrolysis agrees essentially with that found previously for a perchlorate medium; however, estimated charges at the lower hydroxyl numbers are substantially less, indicating complexing of the thorium species by nitrate. Results indicate equilibrium solutions and degrees of polymerization near unity at hydroxyl numbers 0 and 1, and degrees of polymerization of 3-4 at hydroxyl number 2. At hydroxyl number 3, a degree of polymerization near 120 was found for clear solutions aged approximately 1 month; after an additional 2-month aging period, an increase of some 25% in molecular weight was observed, with solutions of Th concentration above 0.07M showing faint visible turbidity. Some preliminary kinetic measurements for thorium solutions hydrolyzed to hydroxyl number greater than 3 are reported.
W69-00998

THE SPECTROPHOTOMETRIC DETERMINATION OF NITRATE IN WATER USING 2-NITROSO-1-NAPHTHOL-4-SULFONIC ACID.
Southern Illinois Univ, Carbondale.
Frank N. Abercrombie, and Albert L. Caskey.
Proj Rep, June 1966. 15 p, 3 fig, 5 tab, 3 ref. OWRR Project A-014-Ill.

Descriptors: *Water analysis, *Chemical analysis, Water chemistry, Chemical reactions, *Nitrates, *Spectrophotometry, Spectroscopy, Analytical techniques, Absorption, Ultraviolet radiation.
Identifiers: Infrared spectroscopy.

2-Nitroso-1-naphthol-4-sulfonic acid reacts quantitatively in a few minutes with excess nitrate in a dilute, acidic, aqueous medium to form 2,4-dinitro-1-naphthol. The work reported here concerns the determination of conditions under which nitrate reacts quantitatively with an excess of standard 2-nitroso-1-naphthol-4-sulfonic acid. The establishment of such a set of conditions indicates the feasibility of developing a spectrophotometric method for the determination of nitrate based on its reaction with 2-nitroso-1-naphthol-4-sulfonic acid. Reagent grade chemicals meeting American Chemical Society specifications were used whenever they were commercially available. All other chemicals were of the highest grade available. Equipment and procedures are described and results indicate that it is feasible to develop a method for the spectrophotometric determination of nitrate utilizing 2-nitroso-1-naphthol-4-sulfonic acid.
W69-01113

ROLE OF CERTAIN STREAM-SEDIMENT COMPONENTS IN RADIOION SORPTION,
U S Geological Survey.
E. A. Jenne, and J. S. Wahlberg.
U S Geol Surv Prop Pap 433-F, pp F1-F16, 1968. 16 p, 4 fig, 7 tab, 41 ref.

Descriptors: *Sorption, *Dialysis, *Radioisotopes, Clay minerals, Carbonates, Oxides, Cobalt radioisotopes, Cesium, Strontium radioisotopes.
Identifiers: Radioion sorption (Sedimentary), Ion manganese.

'Natural' and laboratory 'dialysis' mass-action selectivity coefficients were determined for the sediment fractions smaller than 0.25 mm and for the 2-0.25 mm sediment fractions to evaluate the comparability of these 2 types of selectivity coefficients and the effectiveness of nonclay components in controlling the distribution of radioions between solid and liquid phases. Stream water and surficial bed sediment were sampled in Whiteoak Creek, Tenn, which carries low-level-radioactive waste waters from Oak Ridge National Laboratory. Appropriate mass-action selectivity coefficients were calculated. Sr-90 sorption was controlled by precipitated carbonates. The selectivity coefficient was 9.6 for the natural carbonates and 1.2 for laboratory dialysis. Co-60 sorption was controlled by Mn and Fe oxides and the natural selectivity coefficients were the higher. Cs-37 sorption was controlled by clay minerals, with higher natural selectivity coefficients. Natural and laboratory selectivity coefficients were not comparable in many instances. This is attributed to partial dissolution of finegrained carbonates and of manganese and iron oxides, and in part to the largely irreversible nature of cobalt-60 and cesium-137 sorption. The laboratory and the natural selectivity coefficients for cesium-137 agreed within a factor of 2. (Knapp-USGS)
W69-01176

2L. Estuaries

ESTUARIES - INVENTORY - STUDY, SENATE REPORT NO 1419.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00781

MUNICIPAL LIQUIDATORS, INC V TENCH (AVULSION AND EROSION).

153 So 2d 728-731 (Fla DCA 1963).

Descriptors: *Florida, Avulsion, Erosion, Judicial decisions, Bank erosion, *Boundary dispute, Boundaries (Property), High water mark, *Ownership of beds, Beds, Beds under water, Water law, Riparian rights.
Identifiers: *Government lots, *Tampa Bay.

This was a suit in chancery for a declaratory decree. Defendant owned a government lot bordering on Tampa Bay. The government survey of 188 showed that at that time defendant's governmen lot included land between plaintiff's property and the waters of Tampa Bay. This part of defendant's lot is now submerged, so that plaintiff's property extends to the water's edge. Plaintiff now seeks to purchase the submerged land in front of his property, including what was formerly part of defendant's government lot, for the purpose of filling. Th

ourt found that the now submerged part of defen-
lant's government lot had disappeared by erosion,
ence title reverted to the state. The court rejected
lefendant's contention that the land was lost by
vulsion, hence title remained in defendant. Where
and becomes submerged, erosion is presumed, and
he burden of proving avulsion is on the party alleg-
ng avulsion. The case discusses the distinction
etween avulsion and erosion. (Kirkconnell-Fla)
W69-00834

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

WATER WELL YIELDS FROM CRYSTALLINE ROCKS OF NORTHERN NEW JERSEY,
Rutgers Univ., New Brunswick.
Bennett L. Smith, and Daryll A. James.
Dept Geol Pub 1968. 8 p, 4 tab, 6 ref. OWRR Project A-007-NJ.

Descriptors: Crystalline rocks, *Water wells, *Water yield, Gneisses, *Groundwater, *Permeability, Faults (Geology), Joints, Granites.
Identifiers: Diorite.

For more than 10 yr, a study has been carried out of the crystalline Pre-cambrian rocks which form the bedrock throughout some 1200 square mi of Northern New Jersey. This has resulted in a new geologic map of the region. As a byproduct of this work, a study of water well yields has been made in relation to lithology and structure, in order to provide guidelines for well development. This report includes an analysis of well yield with respect to rock type. It also includes certain findings as regards relationship of well yield to geologic and topographic structure. Further details including findings relative to structure will be incorporated in a publication, now being prepared.
W69-00707

SUBSURFACE FLOW IN A SOUTHERN ILLINOIS FRAGIPAN SOIL,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00717

WATER-RESOURCES APPRAISAL OF CLAYTON VALLEY-STONEWALL FLAT AREA, NEVADA AND CALIFORNIA,
U S Geological Survey, Washington, D C, Water Resources Division.
F. Eugene Rush.
Nev Dep of Conserv and Natur Resources, Water Resources-Reconnaissance Ser Rep 45, 54 p, May 1968. 3 fig, 1 plate, 16 tab, 34 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, Data collections, Hydrologic data, Water quality, Water yield, Nevada, California, Alluvium, Valleys.
Identifiers: Clayton Valley-Stonewall Flat area, Nevada.

A reconnaissance water resources study was made of the Clayton Valley-Stonewall Flat area of Nevada and California. The area 80 miles north to south and 60 miles east to west, has a population less than 1,000. The valleys are bounded by mountain ranges about 9,000 ft high. Most of the available groundwater is stored in valley-fill alluvium, which is 600 or more ft thick. The valley flats receive about 5 in. precipitation a yr; most recharge is stream water from the mountains, where precipitation is as high as 15 in. per yr. Perennial yield is estimated to be 22,000 acre-ft per yr in Clayton Valley and from 100-3,000 acre-ft per yr in the smaller valleys of the area. Present groundwater development in the area is only 2,090 acre-ft per yr. The water is of fair to poor quality for agricultural use and marginal in quality for drinking. Chloride, sulfate and TDS are excessive. Tabulated data include hydrologic, topographic, climatic, and drainage summaries, runoff, evapotranspiration, pumpage, groundwater budgets, chemical analyses, perennial yield, transitional storage reserve, well data, spring data, and drillers' logs of wells. (Knapp-USGS)
W69-00935

MANAGEMENT OF HYDROLOGIC SYSTEMS FOR WATER QUALITY CONTROL,
California University, Berkeley, Water Resources Center.
Philip C. Woods.
Calif Univ Water Resources Center Contrib No 121, 121 p, June 1967. 39 fig, 4 tab, 56 ref, 1 append. OWRR Project A-004-Cal.

Descriptors: *Water quality control, *Management, *Simulation analysis, *Model studies, Mathematical models, Linear programming, Systems analysis, Irrigation practices, California, Flow augmentation.
Identifiers: *Hydrologic systems, Sacramento River, Hydrologic models.

Management of hydrologic systems entails not only the design and construction of physical works for supplying water and removing waste water but considers the impact of these operations on water quality throughout the system. As an example of hydrologic system behavior, irrigation systems, which may be represented as controlled hydrologic entities, were examined. A systematized approach for predicting the quality response of these systems to changes in irrigation practice was proposed, and a series of mathematical models through which river system operation could be simulated on a digital computer was suggested. These models were described, and results obtained by simulation of the Sacramento River System were compared to the quality response of the prototype. Among the parameters which could be manipulated for system management, flow augmentation and ground water elevation control were shown to be significantly effective. The most dramatic changes in system response, however, resulted from changes in irrigation operations. Simulation approaches lead to the ultimate management goal of optimization techniques. (Knapp-USGS)
W69-00938

THE AVAILABILITY OF SUB-SURFACE WATER IN MISSOURI FOR CONSUMPTIVE USE BY PLANTS,
Missouri Univ., Columbia, Soils Dept.
For primary bibliographic entry see Field 02D.
For abstract, see .
W69-00999

WATER CONSUMPTION BY PHREATOPHYTES,
Arizona Univ., Tucson. Dept. of Watershed Management.
Paul G. Sebenik, and John L. Thames.
Prog Agri, Vol 14, No 2, pp 10-11, March-April 1967. 2 p, 1 tab.

Descriptors: *Phreatophytes, *Arid climates, *Consumptive use, *Transpiration, Evapotranspiration, *Tamarisk, Water loss, Evaporation pans, Measurement, Brush control, Arizona.
Identifiers: Tents.

Phreatophytes in the 17 western states occupy about 15 million acres of stream bank and river bottom sites and consume large quantities of water. Transpiration by tamarisk shrubs occupying a narrow flood plain near Winkleman, Arizona, was measured during the summer of 1966 by the tent technique. On all days of measurement, evapotranspiration from areas enclosed by the tent exceeded pan evaporation. An average monthly loss of 1.1 acre-feet of water per acre occurred from July to September. Suggestions on how this water could be salvaged for more valuable use were given together with problems that arise when phreatophytes are removed from river channels. Since phreatophytes occur in large numbers along streams and rivers in arid areas, their contribution to water losses that occur in these areas must be studied and understood. (Blecker-Ariz)
W69-01012

ATTRACTION OF ATMOSPHERIC MOISTURE BY WOODY XEROPHYTES IN ARID CLIMATES,
Volcani Institute of Agricultural Research, Rehovot, Israel.
I. Gindell.
Commonwealth Forest Rev, Vol 45 (4), No 126, pp 297-321, December 1966. 25 p, 11 fig, 8 tab, 33 ref.

Descriptors: *Arid climates, Moisture tension, *Soil moisture, Soil-water-plant relationships, Precipitation (Atmospheric), *Xerophytes, *Tamarisk, *Meteoritic water, Dry seasons, Wet seasons, Plant physiology, Humidity.
Identifiers: Ionic concentration, Moisture index, Israel.

The participation of atmospheric water in the arid climates with respect to the control of water shortage in woody xerophytes and in the reduction of moisture tension in the soil was followed in three ways: (a) By comparison of soil moisture in forest plantations with that of neighboring bare areas of identical make-up. (b) By comparing the fluctuations in soil moisture in the two areas during the dry and rainy seasons. (c) By investigation of the process of entry of water into the leaves, its passage into the stem and roots and the egress of the excess into the soil surrounding the roots. In the desert region, there was no reduction in the foliage of various species of tamarisk during the driest and hottest months of the year. In the desert, in deep sands, absorption from great depth (270cm) was possible owing to the gradual decrease in moisture with depth. (Blecker-Ariz)
W69-01014

PREPARED WATER CATCHMENTS,
G. H. Young.
J Agr S Australia, Vol 69, No 2, pp 73-77, September 1965. 5 p, 1 tab, 7 photo.

Descriptors: *Arid climates, *Watersheds (Basins), *Runoff, *Water conservation, *Costs, Grading, Erosion control, Contour furrows, Dams, Weed control, Roads, Channels.

Two methods are described which have been used to increase runoff and improve catchments of farm dams in the Eyre Peninsula of South Australia. The road-type catchment is a series of roads side-by-side across the slope of the land. It is found to be extremely effective in flat areas where runoff does not occur except after heavy storms. Cost for each stage of the catchment construction is given. The contoured catchment is used in hilly country with slopes ranging from 5-15%. Cost of constructing a contour catchment is similar to the road-type catchment. These methods are but two more ways in which water harvesting can be done in arid climates. (Blecker-Ariz)
W69-01016

ECONOMICS OF WATER CONSERVATION WITH MONOMOLECULAR FILMS: PART I,
Waterloo, Univ., Ontario, Canada.
P. L. Silveston.
Amer. Soc. of Agr. Eng. Trans. Vol 8, No 1, pp 127-134, 137, 1965. 9 p, 14 fig, 3 tab, 27 ref.

Descriptors: Economic efficiency, *Water conservation, Alcohols, *Monomolecular films, *Evaporation control, Cost-benefit analysis, *Farm ponds, Climatic data, Application methods, Instrumentation, On-site tests, Ponds, Films, Retardants, Winds.

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Identifiers: Dusting.

This paper examines the cost of increasing the capacity of farm ponds by suppression of evaporation through use of monomolecular films of long-chain fatty alcohols. Cetyl alcohol and stearyl alcohol were found to be among the most effective compounds for reducing evaporation and were the most promising in regard to cost and availability. In order to estimate cost of water saved by evaporation suppression, both amount of evaporation and percent reduction obtained for given treatintg conditions must be known. Summaries of many field test observations were presented in a table together with a summary of cost assumptions and a comparison of treating method costs for a one-acre pond. Two hypothetical cases illustrated how data and procedures given in the paper could be applied. (Blecker-Ariz)
W69-01017

AN APPLICATION OF PRINCIPAL COMPONENT ANALYSIS AND FACTOR ANALYSIS IN THE STUDY OF WATER YIELD.
Tennessee Univ, Knoxville, Tennessee.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01064

WATER RESOURCES OF DELAWARE COUNTY, INDIANA,
U S Geological Survey, and Indiana Department of National Resources.
R. E. Hoggatt, J. D. Hunn, and W. J. Steen.
Indiana Div of Water Bull No 37, 57 p, 1968. 23 fig, 1 plate, 8 tab, 27 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, Water quality, Aquifers, Data collections, Indiana, Water yield, Streamflow.
Identifiers: Delaware County (Indiana), Muncie (Indiana).

Delaware County, Indiana has ground and surface water resources of sufficient quantity and quality to meet present needs and predicted increased requirements for agricultural, domestic, and municipal use. Present use, 80% of which is Muncie municipal water, totals about 18.5 mgd of which 63% is from surface sources. Muncie's water supply is obtained from the White River, which flows more than 20 cfs or 13 mgd 90% of the time from a drainage area of 242 sq mi. Low flow is augmented by releases from Prairie Creek Reservoir. The Mississinewa River drains 304 sq mi and yields over 8 cfs 90% of the time; its development potential is good. Streams in the northern part of the county frequently go dry, but in the southern half, most yield over 0.013 mgd per sq mi 90% of the time, Buck Creek yields over 6.5 mgd 90% of the time. Aquifers within 400 ft of the surface yield neraly all the groundwater. Well can yield as much as 1,000 gpm in the south central and southwest. The principal aquifers are silurian dolomite, which yields up to 500 gpm, and Pleistocene sand and gravel, some of which fills buried valleys. The waters of the county are moderately hard. Some groundwater may have excessive iron. (Knapp-USGS)
W69-01177

STUDIES OF CONSUMPTIVE USE OF WATER BY PHREATOPHYTES AND HYDROPHYTES NEAR YUMA, ARIZONA,
U S Geological Survey.
For primary bibliographic entry see Field 02I.
For abstract, see .
W69-01178

WATER RESOURCES OF THE LETTSWORTH-INNIS-BATCHELOR AREA, POINTE COUPEE PARISH, LOUISIANA,
U. S. Geological Survey.
A. H. Harder, V. B. Sauer, and W. L. Broussard.
Louisiana Dep of Conserv Geol Surv and Dep of Public Works Water Resources Pam No 21, Jan 1968. 1 plate, 6 tab, 6 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, Data collections, Water quality, Water yield, Louisiana, Mississippi River Basin.
Identifiers: Pointe Coupee Parish (Louisiana).

Large quantities of surface and groundwater of good quality are available in Pointe Coupee Parish, Louisiana. The nearby Mississippi River has an average flow of about 600,000 cfs and a minimum flow of about 75,000 cfs. Dissolved-solids concentrations in the river range from about 110 to 400 ppm, hardness from 70 to 200 ppm, sediment from 50 to 3,500 ppm, and pH from 6.7 to 8.2. Raccourci Old River, which is connected to the Mississippi River, contains about 15 to 30 billion gal of water, depending on its stage and that of the Mississippi River. The quality of its water is similar to that of the Mississippi River. Large quantities of fresh groundwater are available from underlying sands in thickness from 20 to more than 100 ft. Large-diameter wells may yield as much as 1,500 gpm each, with specific capacities up to 75 gpm per ft of drawdown. Groundwater levels range from a few ft below land surface in wells screened at depths of 50-400 ft deep to as much as 15 ft above land surface in wells screened from 1,000 - 1,200 ft deep. The quality of groundwater improves with depth. Wells less than 400 ft deep usually yield a calcium bicarbonate type water that is hard and high in iron. Deeper wells (400 to 1,200 ft) usually yield a softer, sodium bicarbonate water having a hardness of 4 to 80 ppm, less iron (0.00 to 1.4 ppm), and a pH of 7.0 to 8.8. (Knapp-USGS)
W69-01183

3C. Use of Water of Impaired Quality

ENGINEERING ASPECTS OF THE RECLAMATION OF SODIC SOILS WITH HIGH-SALT WATERS,
Dept. of Agriculture, Mandan, No. Dakota, Agricultural Research Service.
Eugene J. Doering, and Ronald C. Reeve.
J Irrigation and Drainage Div, ASCE, Vol 91, No IR 4, Proc Paper 4588, pp 59-72, Dec 1965. 14 p, 6 fig, 2 tab.

Descriptors: *Saline water, *Alkaline soils, Fine-textured soils, *Land reclamation, Hydraulic properties, Hydraulic conductivity, *Leaching, Electrolytes, *Sodium, Soil chemistry, Soil profiles, Infiltration, Ions, Cation exchange, Percolation, Permeability, Equations, Gypsum.
Identifiers: *Engineering aspects.

A laboratory study was conducted to show that sodic fine-textured soils were impossible to reclaim by applying gypsum to the surface and that the high-salt-water dilution method was effective within limits. A combination of the two methods appeared to be both effective and practical. Basic principles and calculation procedures involved in the engineering evaluation of a reclamation program were presented. Hydraulic properties of sodic soils were functions of both electrolyte concentration of the leaching solution and exchangeable-sodium status of the soils. They were also dependent on the previous history of the sample. Therefore, estimates of time needed for reclamation must still be based on empirical determinations of the infiltration rate for the soil in question. (Affleck-Ariz)
W69-01023

USING SALT TO INCREASE IRRIGATION WATER,
Arizona Univ, Tucson, College of Agriculture.
Brent C. Cluff, and Gordon R. Dutt.
Reprint, Prog Agr Ariz, Vol 18, No 3, pp 12-13, May-June 1966. 3 p, 4 fig. OWRR Project A-001-ARIZ.

Descriptors: Watershed management, *Water yield, Water storage, Water utilization, Sodium chloride, Soil sealants, *Runoff, Irrigation water.

Sodium chloride was added to soil material in pans and on a field plot. It was found that the 'Mo' effectively dispersed and sealed the surface, thus increasing runoff. During the last half of the winter rainfall period, runoff was 25 times greater on the treated plot than on the check plot. Of the 2.90 in. of precipitation, 10.3% was measured as runoff from the treated plot. The runoff from the salted plot contained less than 200 ppm dissolved salts. It was estimated that the treatment cost could be below $12.00 per acre.
W69-01160

3D. Conservation in Domestic and Municipal Use

URBAN WATER USE STUDY,
Colorado Univ., Boulder and Mexico Secretaria De Recursos Hydraulicos.
J. Ernest Flack, and Fortunato Martinez.
Amer Soc Civ Eng, Conf Preprint 350, May 1966. 38 p, 4 fig, 14 tab, 5 ref. OWRR Project A-005-Colo.

Descriptors: *Urban areas, *Water utilization, Water costs, Colorado, *Municipal water, Cities, Municipalities, Elasticity, Return flow, Consumptive use (Water), *Industrial water.

A study was made of domestic and industrial water consumption in the cities of Boulder, Denver, and Colorado Springs, Colorado and Monterrey, Nuevo, Mexico. Available data limited study to the period 1957-1964. Results show trends of interest which should be of value in future water supply studies.
W69-00721

3F. Conservation in Agriculture

RECESSION CHARACTERISTICS OF IOWA STREAMS: PART I - TEMPORAL AND AREAL DISTRIBUTION OF RECESSION CONSTANTS,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-00718

MANAGEMENT OF HYDROLOGIC SYSTEMS FOR WATER QUALITY CONTROL,
California Univ., Berkeley.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00724

FEDERAL PROJECTS FOR IRRIGATION AND WATER SUPPLIES.

43 USCA Secs 390-390f (1964).

Descriptors: *Legislation, *Federal project policy, *Cost allocation, Irrigation programs, Federal Reclamation Law, Cost repayments, Federal government, State governments, Local governments, Water resources development, Leases, Dams, Reservoirs, Reservoir storage, Water storage, Water rights, Water policy, Cost-benefit theory, Projects, Water supply.
Identifiers: *Secretary of the Interior, Secretary of the Army, Corps of Engineers, Bureau of Reclamation.

Whenever the Secretary of the Army determines that any dam or reservoir project under his direction may be used for irrigation purposes, the Secretary of the Interior is authorized to construct and maintain such additional works in connection therewith as he may deem necessary for irrigation purposes. These works may be undertaken only after specific authorization by Congress. Section 390b declares that it is the policy of Congress to recognize the primary responsibilities of state and local interests in developing water supplies and that

he Federal Government should cooperate with the tates and local interests. Section 390b also conains several provisions for the determination and llocation of costs on such projects. The other secions deal chiefly with the acquisition of rights in uch projects by state and local interests, their bligations for operation, maintenance, and costs, nd with contracts and lease revisions concerning hese rights and obligations. The source includes istorical notes and notes of decisions, and is kept p to date with annual supplements. (Smodish-Fla)
V69-00757

IOOVER V CRANE (REASONABLE USE RULE APPLIED TO IRRIGATION).

62 Mich 36, 106 NW 2d 563-566 (1960).

Descriptors: *Michigan, Civil law, Judicial decions, Irrigation, Irrigation effects, Effects, Evaporation, *Reasonable use, Artificial use, Competing uses, *Riparian rights.

Plaintiff owned a lake-front cottage. Defendant's arm also fronted on the lake, occupying about ten ercent of the lake frontage. In the summertime the vater level of the lake often fell so low that the flow t the lake's single outlet ceased. During one such ry period, defendant began pumping water from he lake for irrigation purposes. Plaintiff sued, laiming that the drop in the lake level that summer as due to defendant's irrigation activities. Defendant contended it was due to natural causes, and hat the irrigation was of great benefit to him and ontributed only slightly to plaintiff's discomfiture. The court, employing the reasonable use rule, held hat an injury that is incidental to a reasonable enoyment of a common right can demand no redress. The reasonableness of the use is determined by its xtent, duration, necessity, and application; the naure and size of the stream, and the several uses to which it is put; the relative injuries and benefits to he various riparian owners; and all other material acts. The court held the defendant's use to be easonable, but affirmed an order of the lower ourt restricting the defendant to removing no nore than one quarter-inch from the lake during hose periods when the level of the lake fell below he level where it flowed from the lake's outlet. (S. Scott-Fla)
W69-00889

MAXIMUM AND OPTIMUM NORMS OF BOG DRAINAGE (RUSSIAN),
A. I. Ivitskii.
Transl by Israel Program for Scientific Transl (IPST) 1968, Cat. No. 1988. Available from CFSTI as TT 67-51317. Trans from Gidrotekhnika: Melioratsiya, No 12, pp 33-42, 1962. 11 p, 2 fig, 4 tab, 16 ref.

Descriptors: *Drainage effects, *Marsh management, *Soil physical properties, *Soil chemical properties, Soil water, Soil-water-plant relationships, Dewatering, Drainage wells, Furrow drainage.
Identifiers: USSR, Bog drainage.

An investigation of the relation between depth of bog drainage and agricultural productivity shows that in many cases productivity is higher with drainage to depths of 350-450 cm than with the more commonly used drainage depths of 130-150 cm. Further depression of water levels to 220-260 cm yielded no further improvement and in some cases caused lower yields. For intertilled crops, including spring wheat, sugarbeet, potatoes, and cabbage, average water depth should be at least 60 cm in April and 100 cm the rest of the growing season. For hemp, depth should be at least 62 cm in April and 112 cm the rest of the growing season. The optimum air regime of the soil occurs with a water depth of 120-130 cm, and the maximum tolerable carbon dioxide level occurs with a water depth of 100 cm. (Knapp-USGS)
W69-00913

SOIL MOISTURE AND SOIL TEMPERATURE CHANGES WITH THE USE OF BLACK VAPOR-BARRIER MULCH AND THEIR INFLUENCE ON PINEAPPLE,
Hawaii Univ., Manoa.
For primary bibliographic entry see Field 02G.
For abstract, see .
W69-00984

SUB-SURFACE IRRIGATION OF TURF AREAS, NOZZLE DESIGN AND SPACING,
Massachusetts Univ., Amherst.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00996

AN ECONOMIC ANALYSIS OF WISCONSIN'S DIVERSION PERMIT SYSTEM FOR AGRICULTURAL IRRIGATION,
Wisconsin Univ., Madison, Agri Econ Dept.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-01000

DEVELOPMENT OF METHODS FOR INCREASING THE EFFICIENCY OF WATER USE IN CRANBERRIES,
Massachusetts Univ., Amherst, Cranberry Exp Sta.
John S. Norton.
Pap, Symp Water Resour Res, June 1967. 16 p, 15 fig, 1 tab. OWRR Project A-005-Mass.

Descriptors: *Cranberries, *Dikes, Irrigation systems, Irrigation efficiency, *Flood irrigation, *Water harvesting, Bogs, Equipment.

Materials were procured for an assortment of temporary dikes for cranberry bogs and 7 dikes were built. Two dikes were vinyl sheeting supported on railings and anchored below ground by 1 by 2 in. wood strips. One dike was aluminum, supported by a wood railing. Three dikes were earth with sheet aluminum cores. Two of the earthen dikes were built over filled-in ditches, the third built on bog surface. The seventh dike was erected on private property but removed prior to testing. Only the sheet vinyl and aluminum dikes were constructed in time for testing in 1966. Considerable difficulty was experienced because of washouts under both the vinyl and aluminum sheeting. Tests will be made on all dikes in 1967 in conjunction with work under Hatch Project No 51. The current trend toward water harvest methods. The equipment consists of an elevator to remove the berries from the water surface, and a blower, ducting, and screen to separate debris from the berries before they are loaded into trucks.
W69-01001

SEALING PONDS CHEMICALLY,
Tennessee Univ., Knoxville.
John I. Sewell.
Agricultural Engineering, Vol 48, No 5, pp 270-71, May 1967. 2 p, 1 fig, 2 photo.

Descriptors: *Ponds, Permeability, *Chemicals, *Sealants, Evaporation control, Ion exchange, Dispersion, *Soil sealants, Farm ponds.

Effectiveness of chemical treatment in sealing ponds against water loss was evaluated on the basis of resulting reduction in permeability of the soil sample. In many cases permeameter discharge rates were taken for 30 or more days before discharges approached steady-state condition. In tests where treatments were ineffective, permeability rates (K) always tended to increase with time. Results of sodium chloride treatments indicated that K decreased for about one week, then rapidly increased. This may be because the reaction between sodium and calcium ions in the soil produces calcium chloride, which is highly soluble in water. As the calcium chloride dissolved, a reversal of this reaction took place. Principles, objectives and procedures of sealing ponds chemically were outlined. (Blecker-Ariz)
W69-01019

EFFECT OF IRRIGATION METHOD ON WATER CONSERVATION,
Utah State Univ., Logan.
Jack Keller.
J of Irrigation and Drainage Div, ASCE, Vol 91, No IR2, Proc Paper 4364, pp 61-72, June 1965. 12 p, 1 fig, 7 tab.

Descriptors: *Irrigation effects, *Water conservation, *Irrigation efficiency, Sprinkler irrigation, Cost analysis, Arid lands, *Economic efficiency, Surface irrigation, Comparative costs, On-site investigations, *Farm management.

Water use efficiency and economic factors as a basis for the selection of irrigation methods for farm systems and projects were examined. A brief review of comparative studies of water application and operational efficiencies was presented. A review of comparative irrigation costs demonstrated the relative cost between methods and facilities when the limiting resource was land or water. The effect of methods on the management of both farms and projects was also considered. A major problem in soil and water conservation in arid regions throughout the world is how adequate but not excessive depths of irrigation water can be economically applied to soils. (Affleck-Ariz)
W69-01021

WATER POLLUTION CONTROL IN SEMI-ARID AND ARID ZONES,
Hebrew Univ., Jerusalem, Israel.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-01024

BASIN FORMING AND RESEEDING OF RANGELAND,
Dept. of Agriculture, Tucson, Soil Conservation Service.
K. R. Frost, and Louis Hamilton.
Trans. Amer Soc Agr Eng, Vol 8, No 2, pp 202-203,207, 1965. 3 p.

Descriptors: *Basins, Planting management, Vegetation regrowth, Semiarid climates, Range grasses, *Revegetation, *Mechanical equipment, Arid lands, *Desert plants, *Soil moisture, Ranges, Soil-water-plant relationships, Seeds, Wet seasons, Dry seasons.
Identifiers: Semidesert, *Reseeding, *Basin forming.

Improvement of semidesert ranges through reseeding is usually unsuccessful because of poor soil moisture conditions. Three mechanical systems for improving success of semidesert ranges were developed and evaluated. The systems were: forming and seeding fan-shaped basins, basin-forming on knifed rangeland and seeding in pits formed by a pitting disk. Sloping fan-shaped basins were a practical device for collecting rainfall for range grass seeding if the soils were suitable. Such basins were formed at a low cost with a tractor and blade designed for this purpose. Moisture penetration of 30 inches in medium soils was possible with four or five high-intensity storms of less than one-half inch each and totaling two inches. Appropriate basins were pressed into loose knifed rangeland by a blister roller. (Blecker-Ariz)
W69-01028

HUMAN RESOURCES AND REGIONAL DEVELOPMENT: SOME LESSONS FROM FRENCH EXPERIENCE,
Kentucky Univ., Lexington.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01099

ASPECTS OF SURFACE WATER RESOURCES - HUMBOLDT RIVER BASIN, NEVADA.
Nevada Univ, Reno.
D. F. Schulke, G. B. Maxey, and P. A. Domenico.

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Water Resour Res Center, Desert Res Inst, Proj Rep 6, Aug 1967. 57 p, 14 fig, 1 tab, 14 ref. OWRR Project A-011-Nev.

Descriptors: *Reservoir storage, *Irrigation water, *Water demand, *Water management (Applied), *Administration, *Surface water, Water permits, Irrigation efficiency, Flood irrigation, Appropriation, Water resources, Nevada, Conjunctive use.

Most streamflow for Humboldt River originates in the Upper Valley Unit, or headwaters in Ruby Range in extreme north eastern part of Nev., and the lower country, north and east sides of the basin with varying water rights for quantity/acre, legth and type application. The river is essentially uncontrolled throughout its course except for one major control structure at Rye Patch just above terminal Humboldt Sink. However, there are at least 16 possible reservoir sites in addition to three reservoirs authorized for construction in the Upper Valley Unit, which could be operated beneficially for irrigation purposes and still operate within flood control capacity as shown by operational studies. Another proposal for supplementation of surface water is that of pumping ground water during periods of deficient streamflow. This would tap highly permeable gravel, which in turn would be rapidly replenished during frequent periods of natural flooding. Preliminary results of studies indicate there is a very good possibility of success for conjunctive use of ground and surface waters. Some type of management body, to be decided after review of possibilities and effectiveness of each body in handling basin problems, will be required if either upstream storage or conjunctive use is implemented in the basin to better utilize water resources. (J. Phoenix-Nevada).
W69-01111

INVENTORY OF IRRIGATION AREAS AND DETERMINATION OF CONSUMPTIVE USE BY AREAS.
New Mexico State Univ, University Park.
Donald C. Henderson.
Agri Exper Sta, N Mex State Univ Final Rep, Jan 1967. 3 p. OWRR Project A-007-NMex.

Descriptors: Irrigation, *Consumptive use (Water), Water requirements, *Maps, *Irrigated land, Water rights, River basins, Water supplies, *Water sources, *Sites, Ground water, Surface water, *New Mexico.

A map was constructed showing location of irrigated lands and source of water and areas of similar consumptive use factors in New Mexico. These maps have been published as research reports by the Agricultural Experiment Station, New Mexico State University.
W69-01131

A BIBLIOGRAPHY PERTAINING TO THE PECOS RIVER BASIN IN NEW MEXICO.
New Mexico State Univ, University Park.
John W. Hernandez, and Thomas J. Eaton, Jr.
Water Resour Res Inst Publ 2, 1967. 50 p, 398 ref. OWRR Project B-003-NMex.

Descriptors: *Bibliographies, *New Mexico, Reconnaissance surveys, Irrigation effects, Semiarid land, Water resources, Water resources development.
Identifiers: Pecos River (N Mex).

This publication is a direct result of a research proposal entitled 'Reconnaissance Study of the Pecos River Basin, New Mexico,' which was the ground work done in preparation for the interdisciplinary, inter-university research proposal entitled 'A Comprehensive Water Resources Analysis of a Typical Overdrawn Basin in an Irrigated Semiarid Area.'
W69-01133

TIME-INTEGRATED THERMAL EFFECTS OF FOREST IRRIGATION.
Pennsylvania State Univ, University Park.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-01141

AGRICULTURAL RESOURCES RELATED TO WATER DEVELOPMENT IN TEXAS,
Texas Agricultural and Mechanical Univ, College Station.
J. R. Runkles, and E. T. Smerdon.
Water Resour Inst, Agri Exper Sta, Texas A and M Univ, Sept 1965. 171 p, 16 fig, 35 tab, 59 ref. OWRR Project A-001-TEX.

Descriptors: Agriculture, *Texas, *Water resources development, Crop production, Cultivated lands, Irrigable land, Irrigated land, Natural resources, Resource allocation, Long-term planning, Planning, Bibliographies.

Texas is now developing a state water plan which will be a basic guide for water resources development in Texas through the year 2020. A special task committee at Texas A and M University assisted the Texas Water Development Board in the evaluation of future agricultural water requirements and its relation to water availability. To develop projections of requirements which would be useful in planning water resource development, the analysis was initiated with four models of agricultural resource requirements and production. Each model includes: (1) restrictions on production, (2) assumptions relative to resource availability and use, and (3) estimates of output with the specified use of resources. This report includes discussion and data concerning Texas' resources and environment, and results of the first two models. The first model gives maximum physical capacity of agriculture in Texas with no economic, institutional, or water restrictions placed on production or marketing of products. The second model gives projected resource use and product output with water available to all irrigable acres, but limited by costs.
W69-01143

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on THE Surface

EVALUATION OF DRAINAGE PROBLEMS IN WATERLOGGED AREAS AND BOLSONS IN NEVADA,
Nevada Univ., Reno.
A. I. Kashef.
Water Resour Res Center, Proj Rep 1, Sept 1965. 12 p, 1 map, 5 ref. OWRR Project A-002-Nev.

Descriptors: Drainage practices, *Drainage water, Drainage districts, Drainage systems, *Drainage programs, Irrigation practices, Water reuse, Saturated soils, *Planning, Artificial recharge, Waste water.

Although existing local drainage systems in Nevada adequately drain presently irrigated lands (drainage of existing areas of high water use is only barely adequate), the prospect of large increases of available water, primarily as a result of surface-water importation, necessitates an evaluation of the need for and the manner of implementation of a general state drainage plan. Considered in this report are preliminary studies of primary importance to such an evaluation: (1) completion of a state soils map, (2) completion of a drainage map, (3) grouping of basins into regional drainage units, (4) evaluation of the water balance in selected basins in order to estimate the amount of water that can be naturally discharged, (5) reevaluation of current irrigation and drainage methods, (6) the possibility of establishing legal controls over the discharge of industrial wastes, and (7) a stepped-up program to determine the feasibility of recycling waste waters by means of ground water recharge. It is not the intention, however, of this report to present engineering solutions for current and anticipated drainage problems, but mainly to point out some of the more important aspects that need special attention.
W69-00738

H A BOSWORTH AND SON INC V TAMIOLA (DRAINAGE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00747

CULBERTSON V GROSS (SURFACE RUNOFF).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00750

BOETTCHER V STROCK (ALTERATION OF FLOW).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00751

TREADWELL V WALDEIER (COMMON LAW RULE OF SURFACE DRAINAGE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00752

TENNESSEE VALLEY AUTHORITY.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00758

TENNESSEE VALLEY AUTHORITY.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00759

REAL PROPERTY - WATER RIGHTS - LIABILITY FOR DISCHARGE OF SURFACE WATER,
Robert E. Hammell.
Mich L Rev, Vol 54, No 4, pp 574-577, Feb 1956. 4 p, 11 ref.

Descriptors: Surface drainage, *Surface runoff, *New Jersey, Civil law, *Judicial decision, Reasonable use, *Repulsion (Legal aspects), Water law, Legal aspects.

This is a case comment on Yonadi v Homestead County Homes, Inc, 35 N J Super 514, 114 A 2d 564 (1955). The corporate defendants purchased a forty-acre tract above the plaintiffs' golf course. Drainage had always flowed from the higher tract through the golf course. Defendant constructed a subdivision, increasing the runoff onto plaintiff's land by 350 per cent, and producing floods in heavy rains. Plaintiffs were awarded an injunction and damages at the trial level, and this was reversed. The civil law rule, common enemy rule, and the reasonable use rule are discussed. New Jersey is a 'common enemy' state. It is pointed out that no matter which rule a state uses, it usually arrives at the reasonable use result through various exceptions, limitations, etc. It is concluded that most courts, although they will not come out and say it, are moving toward the more flexible reasonable use approach to surface waters. (R. F. Williams-Fla)
W69-00764

IKE COUNTY BD OF EDUC V BELFRY COAL ORP (INJUNCTION AGAINST DRAINAGE LOODING).
or primary bibliographic entry see Field 06E.
or abstract, see .
V69-00788

N ACT AUTHORIZING THE STATE OF INDI-NA TO COOPERATE WITH THE UNITED TATES IN THE CONSTRUCTION, OPERA-ION AND MAINTENANCE OF MULTIPLE-URPOSE RESERVOIRS.
ndiana Acts 1967, Ch 100. 2 p.

Descriptors: *Indiana, *Federal government, Multiple-purpose projects, Flood control, Water upply, Water quality control, Recreation, State overnments, Legislation, *Administrative agen-ies, Costs.
Identifiers: *State-federal cooperation.

ection 1 recognized that unregulated flow of ivers and streams has detrimental effects upon the tate and that Indiana should cooperate with the Jnited States or any other agency to improve flow egulation. Section 2 declares that storage reser-oirs providing for flood control, water supply, vater quality control, navigation and recreation are n the public interest of Indiana. Section 3 directs he Department of Natural Resources to cooperate vith the United States in the planning, construc-ion, operation and maintenance of various multi-le-purpose projects and to share in the costs hereof. Such funds are to be included in the De-partment's Biennial budget request. (R. F. Wil-iams-Fla)
W69-00790

PETTENGILL V TURO (OBSTRUCTION OF WATERCOURSE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00797

VAN SZYMAN V TOWN OF AUBURN (DRAINAGE - EASEMENTS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00809

CHESARONE V PINEWOOD BUILDERS INC (DRAINAGE SYSTEM).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00811

CITY OF ATLANTA V WILLIAMS (SURFACE DRAINAGE).
For primary bibliographic entry see Field 06G.
For abstract, see .
W69-00825

TIEDEMAN V VILLAGE OF MIDDLETON (CITY'S DISCHARGE OF SURFACE WATER IN ACCORDANCE WITH NATURAL FLOW).

25 Wis 2d 443, 130 N W 2d 783-790 (1964).

Descriptors: *Wisconsin, Judicial decisions, *Cities, *Surface runoff, Surface drainage, Culverts, Embankments, *Natural flow.
Identifiers: Injunctions.

Appellants brought suit against defendant city to enjoin it from using a new drainage system which discharged water through a culvert under a railroad embankment into a pond on appellants' lands. Prior to the installation of the culvert, the natural drainage was such that, in the absence of the railroad embankment, it would have found its way into appellants' pond. The trial court denied relief, and the Supreme Court of Wisconsin affirmed. With regard to surface waters, cities have the same rights as individuals. As long as the city does not tap a new watershed or increase the volume, it may channel surface water in its natural direction. A city may even change the natural flow by the construction of streets and gutters as long as it does not collect water in a body and then cast it on private land. Appellants had not obtained a prescriptive right to have the embankment shield them from surface drainage since the element of reliance was lacking. Injunctive relief was not warranted because appellants suffered no irreparable injury. (R. F. Williams-Fla)
W69-00826

BEHM V KING LOUIES BOWL, INC (DRAINAGE OF SURFACE WATER).

350 S W 2d 285-291 (Mo 1961).

Descriptors: *Surface waters, *Drainage, *Drainage water, *Repulsion (Legal aspects), Water law, Legal aspects, Surface runoff, Riddance (Legal aspects), Floods, Rain water.

The main question in the tort action was whether the defendant was liable for damages caused by the manner in which surface water drained off its property. The court noted it is settled law that surface water is a common enemy which every man may ward off his land and throws on a lower owner, providing he does not collect it and discharge it to another owners damage. The defendant should have anticipated that the placement of railroad ties along the edge of his property would prevent water from being drained from the lot along the lines of natural flowage but would be diverted and caused to flow in a different channel in a damaging flood onto the plaintiff's lower property. The court held that the jury could have found the defendant guilty of actionable negligence and liable to the plaintiff for damage to his property for having caused it to be flooded in the manner that it was. (Horner-Fla)
W69-00827

CHAPPELL V WINSLOW (DIVERSION OF SURFACE WATER).
258 N C 617, 129 S E 2d 101-107 (1963).

Descriptors: *Drains, *Drainage systems, *Runoff, Drainage, Natural flow, Drainage effects, Floods, Surface water, Groundwater, *North Carolina.

The plaintiff sought to enjoin the defendants from altering the natural flow of water. The plaintiff claimed that if the defendant opened certain drainage ditches into the ditch running in front of his property, flooding could result and his land would be injured. The court affirmed the trial judge's finding that the plaintiff could be injured. In an action to enjoin one from collecting and discharging surface waters in volume, it is not necessary to prove that actual injury has already occurred. The remedy is preventive and may be had upon proof that the act complained of, unless restrained, will result in damage. (Horner-Fla)
W69-00828

PENDLETON V STUTTGART AND KING'S BAYOU DRAINAGE AND IRRIGATION DIST (ATTEMPTED WITHDRAWAL FROM DRAINAGE DISTRICT).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00829

DAY V MUMMEY (STORM DRAINS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00830

REUTNER V VOUGA (DRAINAGE).
367 S W 2d 34-43 (St Louis Ct App, 1963).

Descriptors: *Repulsion (Legal aspects), Drainage, Surface runoff, Drainage water, Easements, Sewers, Subsurface drainage, Legal aspects.

The plaintiff and the defendant owned adjoining tracts of land. The plaintiff granted an easement to the city to build a sewer across his property. The defendant in the process of subdividing his property, dug a ditch on the easement to carry water off his land. The plaintiff sued for trespass to his land. The court held that the defendant was not entitled to build a ditch on the easement given to the city and the plaintiff was awarded damages in an amount equal to the cost of refilling the ditch and restoring the land. The court further noted that the defendant should be enjoined from discharging water collected through his sewer system upon the plaintiffs land. Under the common-enemy rule, one landowner may fend off surface waters without regard to his neighbor but he may not artificially collect and impound surface water and cast it in concentrated quantities onto the servient estate. (Horner-Fla)
W69-00832

FURTEK V WEST DEER TOWNSHIP (CLOSING DRAIN RESULTING IN INCREASED SURFACE WATER FLOW).
191 Pa Super 405, 156 A 2d 581-587 (1959).

Descriptors: *Surface water, *Drains, Watershed, Water flow, Gully, Conduits, Surface runoff, Time of concentration, Running water, *Surface drainage, Drainage, Culverts, Easements, Drainage effects, Drainage patterns, Drainage water, Subsurface drains, *Pennsylvania.

Action for continuing trespass against the township for the closing of a drain and the subsequent additional flow of surface water onto the plaintiff's property. Before the closing of the drain, three drains had carried water from the street down to the lake. The plaintiffs' property was at the lower end of the watershed. Before the drain was closed the plaintiffs had noticed some flooding of their property, but only at periods of hard rain. After the drain was closed a deep gully appeared along the line of the drain pipe that passed through the plaintiffs property making it unfit for any use. The plaintiffs had requested the township to take some action and commenced this suit only after the township refused to take any action. The township contended that they had the right to close and abandon any surface water drain without liability and that the plaintiffs' predecessor-in-title's consent release them from all liability. The court found that the closing of the drain caused more surface water to flow onto the plaintiff's property than had before and that the terms of the release should not be construed to cover matters which were not intended or contemplated, and therefore the township was liable. (Rief-Fla)
W69-00833

ARMSTRONG V WESTROADS DEVELOPMENT CO (SURFACE DRAINAGE).
380 S W 2d 529-538 (Ct App Mo 1964).

Descriptors: *Missouri, *Judicial decisions, *Surface runoff, Surface drainage, Streams, Riparian rights, Repulsion (Legal aspects), Natural flow, Culverts, Obstructions to flow.
Identifiers: *Non-riparian land.

Plaintiff Armstrong brought a suit for damages against Westroads Development Company and other defendants. Defendants, in connection with the construction of a shopping center, enclosed a natural stream in a concrete tube or culvert. The natural surface drainage fro.n plaintiff's property had gone into this stream, and consequently such waters backed up on his property, causing damage thereto. Although plaintiff's property did not bound on the stream, he claimed that he had a right to have the stream continue its natural flow, and that anyone obstructing that flow was liable for damages caused thereby. The court held that the

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right to the natural flow of a stream belonged only to a riparian owner thereon. Since plaintiff was a non-riparian owner he did not have a cause of action against defendant. The court pointed out that Missouri accepts a modified 'common enemy' rule as to diffused surface waters, and that if the landowner between plaintiff and the stream had so chosen he could have erected a barrier and completely repelled all drainage from plaintiff's land. (R. F. Williams-Fla)
W69-00836

PETERS V SHULL (COLLECTION AND DISCHARGE OF SURFACE RUNOFF).

379 S W 2d 837-842 (Mo 1964).

Descriptors: *Judicial decisions, *Missouri, *Surface runoff, Drainage, Surface drainage, Reasonabl use, Damages, *Alteration of flow, Water law, Legal aspects, Repulsion (Legal aspects).
Identifiers: Damages (Legal aspects).

Plaintiff brought suit against defendant for allegedly changing the grading and raising part of its adjoining lot, thereby artificially impounding water in one body and discharging it on plaintiff's land, causing damage. Defendant had begun construction of a house, and had changed the natural lay of the land. The trial court found for the plaintiff. Defendant appealed and the Kansas City Court of Appeals affirmed. The court said that a dominant owner may not allow surface water to accumulate on his property and then discharge it at a single point, damaging to the property of the servient owner. The evidence properly showed such actions in this case. The measure of damages is the difference in market value of the land immediately before and after the injury, where, as here, the injury is permanent and substantial. (R. F. Williams-Fla)
W69-00838

SPICER V WHITE BROS BUILDERS INC (DRAINAGE SYSTEMS).

193 N E 2d 274-279 (Ohio 1962).

Descriptors: Sewage, Septic tanks, *Sewage disposal, Titles, *Drainage systems, Channels, Sewage effluents, Damages, Earth dams, Surface water, *Ohio, Tile drainage, Ditches, Drainage water, Rivers, Watercourses (Legal).

This is an appeal by defendant from a judgment enjoining it from draining water or sewerage from Southwood subdivisions onto or across the lands of plaintiffs and ordering it to correct the drainage flow. The court here reversed stating that a preponderance of the evidence shows that the surface water draining into the ravine from the north end of Southwood consists with minor exceptions, of water which normally would have drained onto or across the lands of plaintiffs. Defendant corporation has merely collected this water and emptied it into the natural watercourse. The fact that such drainage, together with the other water draining therein, fills the old river bed is not due to any act of the defendant. The court also held that the defendant was not absolved by this action. The difficulty was that the plaintiffs failed to establish their claims by that degree of proof necessary to warrant this court to order the injunctive relief sought by plaintiffs. (R. Smith-Fla)
W69-00840

MUNN V HORVITZ CO (PRESCRIPTIVE RIGHTS).
175 Ohio St 521, 196 N E 2d 764-769 (1964).

Descriptors: Surface drainage, *Drainage systems, Drainage water, Land development, *Ohio, *Watersheds (Basins), Drainage, Runoff, Streams, *Prescriptive rights, Floods, Flood damage, Diversion, Streamflow, Tiles, Municipal wastes, Surface water.

The court here affirmed a lower court decision dismissing the plaintiffs' petition to enjoin completion of a project to enlarge an existing surface drainage system. The court held that an upstream municipality may collect, by means of sewers, the surface water from a watershed area within the corporate limits and channel it into a natural watercourse which originates in or passes through such watershed area within the municipality, thus increasing the volume and accelerating the flow of water in the watercourse, without incurring liability to the downstream municipalities of landowners. The court also held that a continuous, open and adverse diversion of surface water from one watershed to another ripens into a prescriptive right after the passage of 21 years from the date the water is first discharged into the second watershed. (R. Smith-Fla)
W69-00843

CRUTCHER V CRAWFORD LAND COMPANY (LEGISLATION).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00847

DIVISION OF BEACHES AND SHORES: JURISDICTION, BOARD OF CONSERVATION, TRUSTEES OF INTERNAL IMPROVEMENT FUND,
Florida, Office of Attorney General, Tallahassee.
James Kynes.
Rep Att'y Gen Fla, 063-67, June 18, 1963.

Descriptors: *Administrative agencies, Adjudication procedure, *Florida, *Administration, Legislation, Beaches, Shores, State governments, State jurisdiction, *Jurisdiction, Beach erosion, Shore protection.

This opinion was in response to a question from the Director of the Trustees of the Internal Improvement Fund. The Director asked what effect Ch 63-40, Laws of Fla, which established the division of beaches and shores in the board of conservation, would have upon the duties of the Trustees in processing applications for installation of piers, docks, wharves, etc. The Attorney General responded that while the new law represented the most recent expression of legislative will as to who should have responsibility for the protection and restoration of beaches and shores, the structures mentioned by the Director were not for the purpose of restoration, conservation, or preservation of beaches and shores. Therefore the Trustees should continue to process applications for their installation. (R. F. Williams-Fla)
W69-00853

SURFACE WATER DATA, ALBERTA, WATER YEAR 1966.
Dep of Energy, Mines and Resources, Inland Waters Branch.

Dep of Energy, Mines, and Resources, Inland Waters Branch, Ottawa, Canada, 1968, 283 p.

Descriptors: *Data collections, *Hydrologic data, *Gaging stations, Streamflow, Discharge (Water), Water year.
Identifiers: Alberta (Canada).

The results of the hydrometric survey of Alberta, Canada, for the 1966 water year are presented. Tabulated data include station descriptions, daily stage or discharge, and summary of monthly and annual data. The station descriptions include location, drainage area, type of gage, period of record, mean discharge, extreme recorded, revisions of previous records, and remarks. (Knapp-USGS)
W69-00918

OCCURRENCE OF LARGE NEMATODE POPULATIONS IN IRRIGATION CANALS OF SOUTH CENTRAL WASHINGTON,
Washington State Univ., Prosser.
L. R. Caulkner, and W. J. Bolander.
Nematologia, Vol 12, pp 591-600, 1966. 12 p, 7 fig, 11 ref, disc. OWRR Project A-011-Wash.

Descriptors: Irrigation canals, Irrigation, *Sampling, Irrigation water, Water analysis, *Nematodes, Analytical techniques, Washington, Plant diseases, Plant pathology, Water pollution effects, *Soil contamination, Columbia River Basin.
Identifiers: Plant parasites.

Studies carried out during the 1965 season at Prosser, Washington showed the presence of large numbers of nematodes in irrigation water. Water samples were collected with a depth-adjustable sampling tube and nemas were extracted using modified screening and Baermann funnel techniques. Efficiency of the method was inversely proportional to the volume of water sampled. Distribution of nematodes within a canal was random as they did not concentrate in any portion of the canal and no tendency to settle out of flowing water was detected. Population densities in the Sunnyside and Roza Canals ranged from approximately 25 to 200 nemas/gal (3.775 l) of water depending upon the date of sampling. Estimates from these data indicate that from 2 to 16 x 10 to the 9th power nematodes per day were carried past a given point. Plant parasitic nematodes generally accounted for 10-20%of those extracted from innigation water with the highest concentration of these occurring during mid-season in the Sunnyside Canal.
W69-01005

DRY VALLEYS AND THE COMPOSITION OF THE DRAINAGE NET,
Exeter Univ. (England), Geography Dept.
K. J. Gregory.
J of Hydrol (Amsterdam), Vol 4, No 4, pp 327-340, November 1966.

Descriptors: *Valleys, *Watersheds (Basins), Channel flow, Linear programming, Drainage systems, *Channel morphology, Arid lands, Streams, *Networks, Regression analysis, *Drainage patterns (Geologic), Stream beds, Hydrologic data, Mapping, Least squares method.
Identifiers: Stream channels, Valley network, Drainage nets.

Many drainage basins in Devon, England, particularly in central and southeast Devon, include dry valleys and the problem of the exact composition of the drainage net is often encountered. Two maps were produced for the Otter drainage basin; one showing the existing network of stream channels and one showing the present network of valleys which included many dry valleys devoid of stream channel at the present time. The maps were analysed for number of streams and number of valleys respectively. The best fit by linear regression was provided by the numbers of stream channels mapped in the field. The analysis of the drainage net according to the first two laws of drainage composition showed that the laws were confirmed by the network of present stream channels. In several basins it would appear that the present channel network should be used in preference to the valley network as the latter includes valleys of different ages which developed and functioned at different times. (Blecker-Ariz)
W69-01007

4B. Groundwater Management

GAMER V TOWN OF MILTON (PERCOLATING WATER).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00748

HATFIELD TOWNSHIP V LANSDALE MUNICIPAL AUTHORITY (WATER WELLS REASONABLE USE).

19 Pa D and C 2d 281-299 (Com Pl 1959).

escriptors: *Reasonable use, Judicial decisions, Water wells, Wells, Percolating water, Cities, Water supply, Ground water, Underground orage, Water table, Competing uses, *Municipal ater, Relative rights, *Pennsylvania.

laintiff sought a permanent injunction to restrain efendant municipal water company from ithdrawing and distributing water to its stomers. Defendant proposed to use as its source water a well which it had obtained by authority eminent domain proceedings. Plaintiffs alleged at such use adversely affected the wells of eighboring property owners. The court held that e use of waters from the defendant's well must be nited to purposes incidental to the beneficial enyment of the land from which they are obtained d if their diversion or sale to others away from e land impairs the supply of water on the propere of another, such is not a lawful purpose. The urt noted that the municipal nature of the defennt created no distinction in its favor, nor did the ct that the water used was to be furnished to the blic put the cause of the defendant in a more vorable position. Although judgment was ndered for the plaintiff injunctive relief was not anted. As an alternative remedy the court quired the defendant to supply free water service the plaintiffs in proportion to their individual sses. (Kuder-Fla)
W69-00784

ORTH CAROLINA WELL CONSTRUCTION CT.
or primary bibliographic entry see Field 06E.
or abstract, see .
W69-00795

ROUND WATER RECHARGE AND ITS OTENTIAL,
exas Technological College, Lubbock.
larvin J. Dvoracek, and Rolland Z. Wheaton.
mer Soc of Agr Eng Southwest Reg, 1968. Annu leeting, Baton Rouge, Louisiana, Apr 1968 Paper), 1968. 6 p. OWRR Project B-016-Tex.

escriptors: *Artificial recharge, *Groundwater echarge, Induced infiltration, Pit recharge, roundwater mining, Injection wells, Recharge ells, Reclaimed water, Water Reuse, Water orage, Playas, Texas.
lentifiers: High Plains, Texas.

he need of and techniques for artificial recharge areas where groundwater is mined are reviewed. the High Plains of Texas there is no developed rainage pattern; 2.5-3 million acre-ft of runoff per collects in playas where 90% of it is lost to vaporation. About 5 million acre-ft a yr of water is eing mined. Recharge would slow the lowering of ater levels, reduce flooding, and reduce the ealth hazard of standing waters. Recharge may be y recharge or multipurpose wells, shafts above the ater table, pits or trenches, rubble cones, and ater-spreading. The best method depends on uantity and quality of water and the physical naure of the aquifer and any overlying formations. uspended material may clog aquifers as may recipitable dissolved solids, particularly in wells nd pits. Clarification of water is often economially justified. Recharge with waste water is practical but may be aesthetically or psychologically isturbing to water users. Nitrates and phosphates ay be chemical problems in such waters when ey are recharged, but not if they are used for irgation. Recharge is a means of handling imported ater when demand is temporarily below supply. egal problems involving ownership of recharged ater must be solved. (Knapp-USGS)
W69-00928

EOLOGIC FACTORS IN COMMUNITY EVELOPMENT AT NAPERVILLE, ILLINOIS,
llinois State Geological Survey.
or primary bibliographic entry see Field 06B.
or abstract, see .
W69-00943

ARTIFICIAL RECHARGE THROUGH AUGMENTED BANK STORAGE,
Princeton Univ., N. J., Civil Eng Dept.
Roger J. M. DeWiest.
Pap, Symp Artif Recharge and Manag of Aquifers, Haifa, Israel, Mar 1967. 28 p, 6 fig, 10 ref. OWRR Project A-011-NJ.

Descriptors: *Groundwater recharge, *Bank storage, Aquifers, Water table, Dams, Trenches, Wells, Hydraulic conductivity, Rivers, New Jersey.

Nonsteady flow is examined for a ground-water recharge project in which rainfall runoff is returned to a water table aquifer in the vicinity of Princeton, N. J. The recharge is accomplished by damming a river and its tributary and by reversing the hydraulic gradient between the river and its connected ground-water basin. Most of the natural recharge to the ground-water table in the area occurs during the rainy season from Nov to late May. With the resulting build-up of ground-water level, effluent discharge to the rivers increases. This increase ultimately is a net loss of fresh water to the ocean. This loss would be reduced significantly by construction of dams. Increased water level in rivers would automatically decrease the hydraulic gradient from ground-water reservoir to the rivers and hence limit the effluent discharge. Simultaneously, the groundwater reservoir would be pumped and this would make available more storage space for retention of a higher percentage of winter-spring rainfall or for quick recharge from flash summer runoff. A geohydrologic description of the watershed is given and various physical parameters entering the study are discussed.
W69-00970

RESEARCH IN GROUND WATER ECONOMICS IN THE HIGH PLAINS AREA OF COLORADO,
Colorado State Univ., Fort Collins, Econ Dept.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-00986

RECONNAISSANCE STUDY OF THE PECOS RIVER BASIN, NEW MEXICO.
New Mexico State Univ, University Park.
John W. Hernandez.
Final Rep, Jan 1967. 4 p, 1 ref. OWRR Project B-003-NMex.

Descriptors: *Ground water, Water resources, River basins, Hydrology, Groundwater geology, Water development, Irrigation, *New Mexico, Mathematical models, Confined water, Systems analysis, Water pollution, River basin development.
Identifiers: Roswell (New Mexico), *Pecos River Basin (New Mexico).

The Pecos River Basin in New Mexico is typical of many in the western United States. The water supply is used almost exclusively for irrigation purposes, irrigation practices include conjunctive use of both surface and ground waters as well as the use of one or the other as a supply, and the ground water in storage is being progressively depleted. Objectives of the project were: (1) to inventory the available water resources, (2) to inventory water resources information and literature available for the Pecos River, N Mex, (3) to review the nature of water resources problems of the basin, and (4) to prepare a comprehensive research proposal designed to generate a decision-making, mathematical model to permit redevelopment of water resources of the basin. The principal water supply problems, particularly those of Roswell groundwater basin were investigated. Because of the geology of the Roswell area, the ground-water system in the area can be studied separately from the water supply of the remainder of the basin. A comprehensive project proposal to develop a model for the optimal utilization of the water supply of the Roswell Basin was prepared based on the information generated in this study.
W69-01134

QUALITY OF THE SHALLOW GROUND WATER IN THE RINCON AND MESILLA VALLEYS, NEW MEXICO AND TEXAS,
U S Geological Survey.
J. A. Basler, and L. J. Alary.
U S Geol Surv open-file rep, 30 p, Aug 1968. 4 fig, 2 tab, 6 ref.

Descriptors: *Water quality, *Observation wells, *Sampling, Conductivity, Texas, Pumping, Groundwater movement.
Identifiers: *Rincon and Mesilla Valleys, Specific conductance.

40 observation wells in the Rincon and Messila Valleys, in New Mexico and Texas, were sampled for chemical analysis. These wells were bailed and pumped when capable of sufficient yields, until the field specific conductance of the water from the well had stabilized. Since complex and varying environmental factors, such as drains, canals, and laterals influence the quality of the shallow groundwater in these valleys, the quality cannot be attributed to a single source. Chemical analyses indicate that the quality of the water in the valleys deteriorates with movement downstream, and also deteriorates laterally away from the river. In most places the shallow groundwater is unfit for domestic use but is acceptable for irrigation use. Periodic water-level measurements are made in the wells to observe the general effect of pumping and of surface-water irrigation practices on the shallow water table in the valleys. A figure explains the classification for irrigation use of the shallow groundwater in the area concerned; a map shows the concentrations of selected chemical constituents in the shallow groundwater and the specific conductance of the water at selected sites. (Llaverias-USGS)
W69-01174

MEMORANDUM REPORT ON TEST DRILLING AT NORFOLK VIRGINIA,
U S Geol Surv, WRD, Richmond, Virginia.
Donald L. Brown.
U S Geol Surv open-file rep, 28 p, 1968. 2 tab, 1 map.

Descriptors: *Recharge wells, *Underground storage, *Testing, *Aquifers, Observation wells, Water chemistry, Water supply, Municipal water, Hydrologic data, Logging (Recording).
Identifiers: Norfolk (Virginia).

A test well was drilled near Norfolk, Va to explore the feasibility of the storage and retrieval of fresh water after injection into an aquifer containing saline water. The test hole was drilled to a depth of 2,587 ft in unconsolidated sediments. No fresh water was found below 100 ft. A sand suitable geologically and hydrologically for injection was found between 900 and 1,000 ft. It is confined between clay beds and is thick enough to hold enough water to supply Norfolk for a considerable time. The water to be injected and the formation water are probably compatible. The water in the formation contains about 1,000 ppm chloride. A lithologic log of the well is included. Chemical analyses of water smaples from various depths in the test hole are tabulated. The location of the well is shown on a map, scale 1:24,000. (Knapp-USGS)
W69-01175

4C. Effects on Water OF Man's Non-Water Activities

AN ACT RELATING TO TOWN ROADS AND COUNTY HIGHWAYS: AMENDING MINNESOTA STATUTES 1965, SECTION 164.07, BY ADDING A SUBDIVISION AND MINNESOTA STATUTES 1965, CHAPTER 163, BY ADDING A SECTION.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00768

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BOETTLER V BOARD OF TOWNSHIP TRUSTEES (CIVIL RULE OF SURFACE RUNOFF).

165 NE 2d 705-712 (C P Summit Co, Ohio 1960).

Descriptors: Water law, Drainage, Drainage water, Drainage control, *Surface runoff, *Surface drainage, Judicial decisions, *Ohio, *Controlled drainage, Drainage systems, Civil law, Drainage effects.

A lower landowner sought equitable relief to require the county to control discharge of surface and stream waters which flowed from higher county land onto the premises of the plaintiff. In constructing an airport the defendant had increased the natural flow of surface waters onto the land of the plaintiff, causing inconvenience and damage. Instead of pursuing his right to injunctive relief, the plaintiff sought to retaliate by constructing a dam and overflow pipe. As a result, large quantities of drainage water were discharged from plaintiff's premises into a ditch adjoining a county road, causing damage to both the ditch and the road. Reciprocal relief was sought by the defendant to enjoin the plaintiff from further damaging its road. In applying the civil rule, the court held that the plaintiff was required to receive only that part of the surface water which naturally passed over his land from the airport. The defendant was therefore held liable for accelerating and diverting surface water over the land of the plaintiff which had no natural outlet on his premises. On the same theory the plaintiff was held liable for damages sustained by the road and ditch. The court apportioned between the plaintiff and defendant the estimated cost necessary to correct and control the drainage situation. (Kuder-Fla)
W69-00782

YOUNG AND SONS, INC V KIRK (MUDFLOW FROM ROAD CONSTRUCTION).
202 Va 176, 116 SE 2d 38-44 (1960).

Descriptors: Drainage, Controlled drainage, Drainage water, *Road construction, Judicial decisions, *Virginia, *Surface drainage, Water law, Construction, *Sediment control, Sediments, Mud, Mudflows, Drainage systems.

Landowners brought an action against defendant contractor for the alleged negligent construction of drainage facilities. While conducting blasting operations in conjunction with a state highway project, defendant constructed facilities to drain diffuse surface water from the construction area. Plaintiff alleged that the drainage facilities were negligently constructed and inadequate to accommodate the volume of water that might reasonably be expected to accumulate in the area. Consequently large quantities of mud had accumulated, damaging the land of the plaintiff and contaminating his water supply. Judgment for the plaintiff was appealed on the ground of insufficient evidence. The court held that the evidence was sufficient to establish the liability of the defendant. (Kuder-Fla)
W69-00785

BODIN V GILL (WATER DAMAGE THROUGH NEGLIGENT DESIGN).
216 Ga 467, 117 S E 2d 325-331 (1960).

Descriptors: *Georgia, Judicial decisions, *Surface runoff, Soil erosion, Depreciation, *Damages, *Contours (Flow control), Architecture (Design), Ponding, Drainage systems, Overflow, Abatement (Flood control).
Identifiers: *Injunctions.

Plaintiff sought an injunction and damages against architects, church and contractor. The plaintiff alleged that the defendants, by altering the contours of the church property in building a new church, had caused water in unnaturally high amounts to run upon and damage the plaintiff's property. The court granted a temporary injunction against all defendants so they could attempt to correct the damaging condition. The architects appealed. This court held the architects could be held for damages for negligent performance of their profession in allowing the faulty design to be put into effect. The ruling was reversed as far as it named the architects as co-respondents to the injunction. Since the architects had completed their portion of the contract and turning the property over to the church some months prior to the plaintiff's suit, they could not have legally disturbed the church's exclusive possession of the land to correct the condition created by their faulty methods. This being so they could not be enjoined at a later date against subsequent injury to the plaintiff's property. (Blunt-Fla)
W69-00786

HOLLEY V STATE (OBSTRUCTION OF DRAINAGE).

128 So 2d 908-911 (Ct App La 1961).

Descriptors: *Floods, *Flood damage, *Drainage, Surface drainage, *Louisiana, Legal aspects.

The plaintiff claimed the highway department's negligent construction of a highway caused an obstruction to natural drainage resulting in the inundation of the plaintiff's property. The court held it incumbent upon the plaintiff to establish by strong, clear and convincing proof that the alleged damages were caused by the defendant's installation of inadequate drainage structures along the highway. The court considered the evidence and decided that the flooding was not due to the insufficiency of openings in the highway. (Horner-Fla)
W69-00789

OFFENSES CONCERNING PUBLIC ROADS AND NAVIGABLE WATERS.
Fla Stat 861.01-861.06 (1967).

Descriptors: *Florida, Legislation, *Obstruction to flow, *Navigable waters, Dams, Non-navigable waters, Damages, Harbors, Water hyacinth, Bridges, Boats, Streams, Dam failure.
Identifiers: Crimes.

Section 861.02 of the Florida Statutes provides a fine of $100 for obstructing a navigable watercourse so that the passage of fish or of boats drawing three feet of water is impaired. Section 861.03 provides a fine of $10,000 and/or imprisonment not exceeding twenty years for willful destruction of a dam used for propelling machinery on any stream within the State. Section 861.04 provides for imprisonment of ninety days and/or a fine of $200 for willfully placing water hyacinths in any of the streams or waters of the state. Section 861.05 provides a fine of $5000 for obstruction of navigable waters by any bridge, whether constructed or to be constructed. Section 861.06 provides imprisonment of two years and/or a fine of $1000 for obstructing a harbor by a steamer, vessel, barge, or lighter; or by any person who violates the provisions of the law relative to the protection of harbors. (Crabtree-Fla)
W69-00855

HARRISON COUNTY V GUICE (OWNERSHIP OF ARTIFICIAL BEACH).

140 So 2d 838-843 (Miss 1962).

Descriptors: Mississippi, Judicial decisions, *Easements, Highwater mark, Right-of-way, Highways, Beaches, *Sea walls, Shore protection, *Accretion (Legal aspects), Riparian rights.
Identifiers: *Littoral rights, Upland owner, Counties.

It was held that where a county acquired an easement for construction of a seawall for protection of a highway and an easement to replace, repair and maintain the seawall and highway, the easement was so limited and no other estate in the lands was acquired. The county condemned a 50-foot strip of land for a right-of-way for construction of a seawall for protection of a highway and such wall was constructed in 1927. In 1951 the county constructed a sloping beach for further protection of the seawall. Since this was not within the easement, the upland owner acquired the beach to the highwater mark in fee simple. (Crabtree-Fla)
W69-00856

BARDWELL V MANISCALCO (DAMAGES FOR OBSTRUCTING SURFACE WATERS).

135 So 2d 84-87 (La 1961).

Descriptors: Louisiana, Judicial decisions, Dams, *Obstruction to flow, *Encroachment, Damages, *Overflow, Ponds, *Dam construction, Laterals, Surface runoff.
Identifiers: Nominal damages.

This was an action for damages resulting from defendant's construction of a dam that encroached on plaintiff's land, obstructed surface flow, and caused an overflow of water onto plaintiff's land. Plaintiff prevailed for nominal damages only because he failed to prove the amount of actual damage. Plaintiff had agreed to the dam construction, but of a smaller dam which was to be totally on defendant's land. (Crabtree-Fla)
W69-00860

GROMMES V TOWN OF AURORA (SURFACE DRAINAGE).

37 111 App 2d 1; 185 N E 2d 3-9 (1962).

Descriptors: Surface runoff, Drainage, *Culverts, Rain water, Surface water, Flooding, Drainage water, Damages, *Illinois, Surface drainage, *Roads, Road construction, Road design, Cultivated lands, Flood damage, Farms, Crops.

Plaintiffs sued defendants for damages resulting from a highway improvement which plaintiffs alleged interferred with the drainage of their farms. A jury returned a verdict for the plaintiffs and defendants appealed. The evidence discloses that the normal drainage of the lands in question was westward from Grommes Farm, then southward across the tract farmed by Schoger, over or under the township road and then southerly to Blackberry Creek. Before the road was resurfaced, plaintiff had never lost a crop due to flooding. The court affirmed the decision on the basis that a municipal corporation in the management of its property is held to the same responsibility that attaches to individuals for injury to the property of others. (R Smith-Fla)
W69-00862

MUNN V HORVITZ CO (INJUNCTION AGAINST STORM SEWER MAINTENANCE).
184 N E 2d 231-239 (Ohio 1962).

Descriptors: *Judicial decisions, *Ohio, Cities, *Prescriptive rights, Surface runoff, Surface drainage, Storm runoff, *Storm drains, Conduits, Conveyance structures, Drainage systems.
Identifiers: Injunctions.

Plaintiff brought suit to enjoin the completion of a project to enlarge a storm sewer emptying into a creek which ran past plaintiff's property. The sewer system had been originally constructed in 1925 by county authorities. Since that time, the area draining into the sewer had greatly changed in character from rural to residential and commercial, with streets, shopping centers and parking lots. The court heard much detailed and technical evidence. The court held that the county and city had gained a prescriptive right to continue to use the sewer together with the right to make improvements thereto necessitated by development of the drainage area by private individuals and by the construction of public improvements. The use of the

ewer had been continuous, open and notorious for ver 37 years. The court also pointed out that laintiff had an adequate remedy at law for any amages sustained from wrongful acts by defen- ants, and that therefore injunctive relief was not arranted. (R. F. Williams-Fla)
/69-00864

UNEAU V MACDONALD (PROPERTY BOUN- ARIES).

73 A 2d 44-47 (N H 1961).

escriptors: *New Hampshire, Judicial decisions, oundaries (Propery), *Boundary disputes, hread of the stream, Public water rights, Local overnments.

aintiff owned property bordered on the west by a ke. The eastern boundary was a publicly owned ad. The south boundary was a line between the ke shore line and the road. The shore line and the ad met at the northern boundary forming a trian- lar piece of property. Plaintiff seeks to prevent efendant from using a wharf located at the orthern boundary of the plaintiff's property. hen property conveyed is bounded by a stream or ghway, it is presumed the property runs to the read of the stream or the center of the highway. ut the city owned the road and thus the rights to e shore line at the northern tip of the plaintiff's roperty. When a wharf is built on navigable water nd bounded by publicly owned property, only an fficial of the public can bring an action to prevent e use of the wharf. Individuals do not have stand- g to enforce the public rights. (Headley-Fla)
/69-00867

ERBER V MERRIT CONSTRUCTION CO (RE- IDENTIAL CONSTRUCTION EFFECTS ON /ATER FLOW).
4 Westmoreland L J 155-161 (Pa Com Pl 1962).

escriptors: *Judicial decisions, *Pennsylvania, easonable use, *Surface runoff, Drainage, rainage water, *Surface drainage, Relative rights, /ater law, Legal aspects.

n this case the defendant was a construction com- any and the owner of a dominant estate. Plaintiff, farmer, owned a servient estate, and contended at the construction by defendant of a road with rainage pipes under it which emptied onto plain- ff's property, caused damage to his property. The ourt found that drainage had always flowed from efendant's property onto that of plaintiff, and that laintiff's property was the only property in the rea which had not been developed for residential urposes. The court further found that defendants' evelopment of its land for residential purposes as a normal, reasonable, and appropriate use of e land, which did not increase the quantity of ater discharged on plaintiff's property or the oints where it was discharged. It held that under ese circumstances the plaintiff was not entitled to amages. Only where the upper owner is guilty of egligence, causing unnecessary damage to the wer owner, or where the upper owner recipitates collected surface water in greatly in- reased quantities upon the lower owner that amages will be awarded. (R. F. Williams-Fla)
/69-00870

OEHDE V WISCONSIN RIVER POWER CO DAMAGE TO FLOODED LAND).
04 F 2d 433-436 (7 CCA 1962).

escriptors: *Flooding, *Dam construction, Damages, Seepage, Dams, Erosion, Percolating ater, Water law, Legal aspects.

he plaintiff owned a tract of scrub land ownstream from the defendants' dam. The defen- ant extracted soil from the plaintiff's land in build- ng the dam which resulted in the partial inundation f the tract. The court held that the difference between the values of the land before and the value of the land afterwards was the proper measure of damages for the partial inundation of property by percolating waters, created by a dam. The plaintiff was also entitled to an injunction preventing further erosion of his land. (Horner-Fla)
W69-00874

BARDWELL V MANISCALCO (DAM CAUSING WATER ENCROACHMENT).
135 So 2d 84-87 (Ct App La 1961).

Descriptors: *Louisiana, *Dams, *Backwater, Dam construction, Judicial decisions, Encroachment.
Identifiers: Damages (Legal aspects).

Plaintiff brought suit against defendant adjoining landowner for alleged damages resulting from a dam constructed by defendant which partially en- croached on plaintiff's land. Natural drainage had been from plaintiff's to defendant's land, into a natural pond partially on the land of both. Plaintiff consented to defendant's proposed construction of the dam as long as it did not encroach on his land. However, the dam was much larger than plaintiff claimed they agreed upon and both encroached on plaintiff's land and caused water to back up on his land. Defendant answered that plaintiff saw all of the construction as it progressed and did not com- plain, thereby manifesting his implied consent. The trial court found for plaintiff, but awarded only nominal damages. The appeal was concerned only with the question of damages. (R. F. Williams-Fla)
W69-00879

KLUTEY V COMMONWEALTH DEP'T OF HIGHWAYS (EFFECT ON WATER OF HIGHWAY CONSTRUCTION).

428 S W 2d 766-772 (Ct App Ky 1968).

Descriptors: *Diversion structures, *Drainage waters, *Civil law, Kentucky, Natural flow doc- trine, Judicial decisions, *Riddance (Legal aspects), Drainage programs, Drainage effects, Comparative benefits, Repulsion (Legal aspects).

This was an action for injunction by the state. Ap- pellant counterclaimed for injunction against the state, claiming that two drainage culverts, con- structed under a new highway, accelerated the flow of water onto their lands, cutting deep ditches and creating a flooding condition. Assuming the state to be in the position of an adjoining land owner, and departing from the civil law rule that the upland owner could not erect artificial structures altering the water flow to the lower estate, the court held that the appellants (lower land owners) could prevail only if the state (upper land owner) un- reasonably changed that natural flow, causing un- natural volumes or unusually swift flows on the lower land. The test was balancing the reasonable- ness of use by the upper owner against the severity of damage to the servient owner. In determining the right of the lower owner to recover, four con- siderations were proposed: (1) necessity of drainage; (2) care taken to avoid unnecessary damage to lower land; (3) benefit to the land drained vis-a-vis detriment to lower land; (4) im- provement of natural drainage or adoption of a reasonable artificial system. One judge dissented. (Storace-Fla)
W69-00882

CISSELL V GRIMES INVESTMENTS INC (DRAINAGE EFFECTS).
383 S W 2d 128-130 (Ky 1964).

Descriptors: Surface drainage, Ditches, *Drainage effects, Surface waters, *Ponds, Natural flow, Land development, Culverts, Sewers, Diversion, Surface, Runoff, Erosion, *Kentucky.

The appeal is from a judgment refusing to grant the appellants injunctive relief and damages against the appellees. The tract of land being developed as a subdivision by the appellees lies on the west wide of Ormsby Lane. The land owned by appellants is located on the east side of Ormsby Lane. The natu- ral drainage from the appellee's tract is across the appellants property and into Big Goose Creek. In developing the subdivision appellees caused a shal- low artificial pond to be eliminated. The court stated that the rule in Kentucky permits the owner of an upper estate to drain and ditch his land for the purpose of carrying off surface water into natural channels by building sewers, gutters and culverts thereon, without liability to the owner of the lower estate, even though such methods of ridding his property of surface water accelerate and increase the flow of water onto the lower estate, so long as he does not divert water from natural drains which otherwise would not have flowed onto the lower estate. On the basis of the above rule the court af- firmed the order. (R. Smith-Fla)
W69-00883

GROSSMAN V JENAD, INC (FLOODING BY ARTIFICIAL CHANNELS).
198 NYS 2d 218-230 (Sup Ct 1960).

Descriptors: *New York, Damages, Flooding, *Ar- tificial watercourses, Flow, Dams, Drainage systems, Judicial decisions, Water law, Civil law, Culverts, Developed waters, Sluices, *Alteration of flow, Streamflow, *Natural flow doctrine, Over- flow, Diversion structures.

A man-made pond on defendant's property, con- structed for the purpose of collecting water from the surrounding terrain, opened by means of a concrete headwall and sluice gate constructed by defendant into a stream that ran across plaintiff's property. Defendant, a land developer, constructed additional artificial channels and pipes which diverted certain surface waters into the stream. Plaintiff sustained damages caused by the greater force and volume resulting from this unnatural in- creased flow of water. The stream had formerly been clear and gentle; after the artificial channels and pipes were constructed, the water carried dirt and debris, the banks became eroded and the rip- rapping became undermined. The court stated that any natural or normal alteration of one's land through reasonable improvements which results in casting surface waters upon the land of another creates no liability unless such surface waters are so collected in drains, pipes, or ditches and cast onto another's premises. Holding that the damages were caused by the artificial channels rather than from heavy rains alone, the court found for the plaintiff in the amount necessary to alter his property to carry off the additional volume of water caused by defendant's installation of the artificial channels. (S. Scott-Fla)
W69-00884

MUEHLHAUSEN V DELAWARE VALLEY HOLDING CO (NEGLIGENT WATERCOURSE RELOCATION).
9 Bucks Co L Rep.

Descriptors: Civil law, Judicial decisions, Legal aspects, Ownership of beds, Relocation, Social needs, Water law, Watercourses, Diversion, Reasonable use, Relative rights, Streamflow, Allu- vium, Erosion, *Relocation, *Pennsylvania, Land- scaping, Sedimentation, Silting, Riparian rights, *Damages.

A rock-bottomed, fast-running stream ran through plaintiffs' wooded property. Plaintiffs widened and deepened the watercourse and constructed small dams and spillways, creating small pools and a con- trolled flow of clear and wholesome water with lit- tle or no sediment or alluvial matter. The water- course in question ran across defendant's land in an irregular course and directly onto plaintiffs' pro- perty. Defendant relocated the channel, but took no precautions to prevent wash or erosion of the new channel, even though the old channel's bed and banks were rock, while those of the new chan- nel were largely dirt. As a consequence, large

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amounts of silt and other eroded matter were deposited within the streambed on plaintiffs' property, filling all its pools. The court held that the defendant had been negligent in relocating the watercourse, and was liable to plaintiffs for the costs of removing the deposits from plaintiffs' land. It is incumbent upon one changing the natural channel of a watercourse to exercise due care in providing and maintaining the substituted channel. (S. Scott-Fla)
W69-00886

JEFFERY V LATHRUP (RELOCATION OF TILE DRAIN).
363 Mich 15, 108 NW 2d 827-831 (1961).

Descriptors: *Michigan, Civil law, Judicial decisions, *Easements, Drainage, Controlled drainage, Tile drainage, Tiles, Surface runoff, Tile drains, *Relocation, Damages, Septic tanks, Saturation, Market value.

Plaintiff purchased a home from defendant, a real-estate developer. At the time of the purchase, the plat for the subdivision showed a 20 foot easement for drainage running over the rear of plaintiff's property and diagonally across the adjacent lot owned by defendant. There was an 8 inch tile line in this easement. Plaintiff had no drainage problems for three years, until defendant relocated the tile drain in preparation for construction of a house squarely across the easement for drainage shown on the plat. As a result, plaintiff suffered damages consisting of saturation and back pressure in his septic tank, causing the toilets and drains in his house to malfunction, and the basement to flood through a floor drain. The court held that under such circumstances defendant would be liable for either present or future damages, or for an amount representing permanent impairment of the value of plaintiff's property. (S. Scott-Fla)
W69-00888

GOLOSKIE V LA LANCETTE (RIPARIAN RIGHTS IN ARTIFICIAL POND).
163 A 2d 325-330 (RI 1960).

Descriptors: *Rhode Island, Judicial decisions, Dams, Riparian rights, Navigable waters, Ownership of beds, Relative rights, Riparian land, Riparian waters, *Farm ponds, Multiple-purpose reservoirs, Ponds, Recreation, Artificial watercourses.

The complainant created an artificial pond on his property by damming up a small brook. He is seeking to enjoin the respondent, who claims a right as a riparian owner to fish and swim in the pond, from trespassing on the pond. In order to have the riparian rights claimed by respondent, it must be shown by evidence that the pond is fed by a navigable river. No such evidence was presented in this case. The fact of flowage from the pond will not bring the shores of the pond to the property bordering such pond. The respondent is not entitled to the riparian rights he claims. (Headley-Fla)
W69-00891

ALLIANCE FOR CONSERVATION OF NATURAL RESOURCES IN PINELLAS COUNTY V FUREN (REVIEW OF ORDER OF COUNTY WATER AND NAVIGATION AUTHORITY ALLOWING FILLING OF SUBMERGED LANDS).
122 So 2d 51-67 (Fla DCA 1960).

Descriptors: Judicial decisions, *Florida, *Beds, Navigable waters, *Landfills, Legislation, Islands, Overflow, Sand bars, Swamps, Standards, Transportation, Recreation, Channels, Erosion control.

The Pinellas County Water and Navigation Control Authority is authorized to regulate and exercise control over the dredging and filling of all submerged bottom lands in the county, together with all islands, sandbars, swamp and overflow lands. The act which created the authority sets up 8 standards which must be met before the authority can grant permission to fill submerged lands. These standards deal with the effect of the proposed plan on such things as transportation, recreation, erosion control, the flow of water, natural beauty, wild life, and other natural resources. If the petition meets these standards then the authority has no alternative but to grant permission. The court determined that the evidence presented at the original hearing supported the granting of permission and the decision of the lower court was affirmed. (R. H. Watson-Fla)
W69-00896

CH 215 - AN ACT RELATING TO EXCAVATING, FILLING AND DREDGING IN AND ADJACENT TO TIDAL WATERS.
Laws of New Hampshire 1967, ch 215, 2 p.

Descriptors: *Legislation, *New Hampshire, Water pollution, Administrative agencies, Landfills, *Dredging, Mining, Excavation, *Tidal waters, Banks, Marshes, Swamps, Aquatic habitats, Bulkheads, Runoff, Shellfish, Marine fisheries, Wildlife.
Identifiers: Equity.

New Hampshire requires that any person who intends to excavate, remove, fill or dredge any bank, flat, marsh, or swamp in and adjacent to tidal waters submit plans of such proposal to the New Hampshire Port Authority at least 30 days prior to the beginning of the work. The Port Authority will hold a public hearing on the proposed project. After the hearing the authority may deny the petition, or may require the installation of bulkheads or other containment structures to prevent subsequent fill runoff back into tidal waters. If the area on which the proposed work is to be done contains shellfish or marine fisheries and wildlife, the director of the N H fish and game department may impose such conditions as he deems necessary for their protection. Any person who violates this statute may be liable for removal of all fill and subject to a maximum fine of $1,000. (R. H. Watson-Fla)
W69-00904

AN ACT RELATIVE TO EXCAVATING AND DREDGING IN PUBLIC WATERS.

Laws of New Hampshire 1967, Ch 274.

Descriptors: *New Hampshire, Legislation, State jurisdiction, Administrative agencies, Administrative decisions, Adjudication procedure, Public rights, High water mark, *Beds under water, *Dredging, *Permits.
Identifiers: Public waters.

A new chapter, 488-A, is added. It provides that no one shall excavate, dredge, or remove any bank, flat, marsh, swamp or lake bed lying below the natural mean high water mark of any public waters, except as therein provided. Natural ponds of more than ten acres are declared to be public waters. An owner of a shore line on public waters may petition the governor and council for permission to dredge in front of his property. The governor and council may grant such permission, upon recommendation of the water resources board and payment of just compensation. Hearings by the water resources board are provided for. A penalty for noncompliance is provided for. The petitioner must pay the costs of the hearings. (R. F. Williams-Fla)
W69-00905

CH 307 - AN ACT RELATIVE TO PLACING FILL IN PUBLIC WATERS.

Laws of New Hampshire 1967, Ch 307, 3 p.

Descriptors: *Legislation, *New Hampshire, *Landfills, Administrative agencies, Water resources development, Ponds, High water mark, Federal government, Piers, Beds.
Identifiers: Public waters.

New Hampshire generally prohibits placing fill i public waters. Public waters include all natura ponds of more than ten acres and all rivers an streams. This prohibition does not apply to th state, federal, or local governments. The governo and council, upon petition and upon recommenda tion of the water resources board, may, for jus consideration, grant to an owner of shoreline o public waters, the right to place fill in the bed o such waters in front of his shoreline. The statut outlines the procedure for obtaining permission t fill. It includes a hearing and publication of th hearing. All costs of the hearing are to be paid b the person soliciting permission. If a person place fill in public waters without permission he is subje to a fine not to exceed $1,000 and may be con pelled to remove the fill by the superior court. (R H. Watson-Fla)
W69-00906

4D. Watershed Protection

LOCAL ACTION AND ACCEPTANCE O WATERSHED DEVELOPMENT,
Mississippi State Univ., State College.
Kenneth P. Wilkinson.
Water Resour Res Inst Rep, 1966. 43 p, 7 tab, 3 ref, append. OWRR Project A-008-Miss.

Descriptors: *Watersheds, *Public opinion, Soci values, Participating funds, Land ownershi *Questionnaires, *Flood control, *Soil erosio *Watershed management, Social aspects, Soci participation.

This is an exploratory study of effects of commun ty structure on projects of watershed developmer Case studies were conducted in 2 communities which community structure had been examined previous research. In one community, where acti in other areas of interest had been carried primarily in special-interest fields, actors in t watershed program were successful in programm efforts to secure local resources. In the seco community generalized community leaders we involved primarily in initiation of the watersh project. A higher level of physical accomplishme was reached in the project in the former and titudes of rural landowners toward watersh development were more favorable. Findings su gest that technical, special-interest projects, su as watershed development, operate more smooth where community structure is less integrate Research concerned with a large number of co munities and a variety of watershed projects needed to specify the optimal level of contact a the conditions under which that level is proached.
W69-00716

AN ACT PROVIDING FOR THE CREATION WATERSHED CONSERVATION DISTRICTS.
South Carolina Laws 1967, No 613.

Descriptors: *South Carolina, Legislation, A ministrative agencies, *Water districts, *Wa conservation, State governments, Governm finance, Taxes, Assessments.
Identifiers: Referendum.

Watershed conservation districts may established within soil and water conservation d tricts. They may execute plans and programs control or prevent soil erosion and floods for conservation, development and utilization of and water resources, and for the disposal of wa Watershed conservation districts may be reques by petition from the residents of the area of proposed district to the soil and water conservat district wherein such area lies. The area involv must be contiguous, within a clearly defi watershed and shall not include lands within a to or other watershed conservation district. Not and a public hearing on the desirability of suc district are required, as is a referendum of the el tors within the proposed district. If the electors prove of the creation of such district, a govern

body of five members is to be elected. The districts are empowered to acquire and dispose of land, construct and maintain works of improvement, borrow money, sue and be sued, and to levy an annual tax. Procedures and limitations on these powers are set out. Provision is made for the discontinuance, by referendum, of watershed conservation districts. (R. F. Williams-Fla)
W69-00793

AN ACT TO ENTER INTO THE CHAMPLAIN BASIN COMPACT, ESTABLISH A COMMISSION TO REPRESENT VERMONT AND REPEAL 10 V S A SECS 172-184.

Laws of Vermont 1967, No 93. 14 p.

Descriptors: *Vermont, *Legislation, New York, Administrative agencies, *Interstate compacts, *Watersheds (Basins), Grants, Budgeting, Financing, Watershed management, Water resources development, Water conservation.
Identifiers: Champlain Basin Compact.

The legislatures of New York and Vermont, having recognized the need for a regional inter-governmental forum for consideration of the problems and coordination of governmental activities in the Champlain Basin, drafted the Champlain Basin Compact. This statute adopts the compact by Vermont, and contains a copy of the compact. New York and Vermont are the original members of the compact, but it also provides for membership of Canada if adopted. The compact provides for general watershed management. The Champlain Basin is defined. Details of the compact are given including finance, development plans, and creation of Lake Champlain Park. (R. H. Watson-Fla)
W69-00900

RATE OF SOLUTION OF LIMESTONE IN THE KARST TERRANE OF FLORIDA,
Florida Univ., Gainesville.
For primary bibliographic entry see Field 02J.
For abstract, see .
W69-00997

WATER MANAGEMENT ON SEMIARID WATERSHEDS,
Dept. of Agriculture, Tucson, Agricultural Research Service.
R. B. Hickok.
17th Annu Ariz Watershed Symp Proc, 1967, pp 9-14. 6 p, 12 fig.

Descriptors: Arizona, *Water management (Applied), *Watershed management, *Semiarid climates, Flash floods, *Sediment discharge, Watersheds (Divides), Economic impact, Erosion control, *Rainfall-runoff relationships, Water utilization, Water yield improvement.
Identifiers: *Walnut Gulch Experimental Watershed (Arizona), Experimental watersheds.

Research conducted on the 58-square-mile Walnut Gulch Experimental Watershed at Tombstone, Arizona, was used to determine optimum utilization of available water, whether on or off the watershed, and control of flash flood and sediment damage. Basic hydrologic processes involved were studied, including their interrelationships and their reaction to various watershed conditions. This basic information was used for predicting and improving behavior of other semiarid rangeland watersheds throughout the Southwest. (Blecker-Ariz)
W69-01022

USDA REPORT ON WATER AND RELATED LAND RESOURCES, POWDER DRAINAGE BASIN, OREGON.
U. S. Department of Agriculture, and Oregon State Water Resources Board, Salem.

U. S. Dep of Agr, Econ Res Serv, 132 p, Jan 1966. 13 fig, 8 map, 33 photo, 26 tab.

Descriptors: *Watersheds (Basins), *Land resources, *Watershed management, *Oregon, Range management, Forest management, Agricultural watersheds.
Identifiers: Flood prevention.

Erosion, flooding, drainage and other water-related problems of the Powder Drainage Basin, Oregon, were assessed in relation to future requirements for water and land resources. Previously recorded data were collected and evaluated; in addition, the USDA River Basin Survey Staff made limited studies to gather basic data not otherwise available, such as physical characteristics of certain reservoir sites, land and water availability and use, needs for tributary watersheds, and forest land resources and ownership. Watershed protection is discussed in relation to agriculture, rangeland, and forestry. Agricultural use of both groundwater and surface water is emphasized. Pertinent tabular data are provided as background information for future work envisaged. (Llaverias-USGS)
W69-01184

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification OF Pollutants

RADIOACTIVITY IN WASHINGTON SURFACE WATER, JULY 1966-JUNE 1967.
Washington State Department of Health, Seattle.

Radiol Health Data and Rep, Vol 9, No 8, pp 438-442, Aug 1968. 5 p, 1 fig, 4 tab, 6 ref.

Descriptors: *Data collections, *Radioactivity, *Monitoring, *Surface waters, Water quality, Radiochemical analysis, Washington, Analytical techniques.

Data from radioanalysis of surface water samples collected in the State of Washington are tabulated. Of the 175 river water samples analyzed in 1966-67, excluding the Columbia River, the total beta radioactivity ranged from 1-26 pCi/liter and averaged 3.0. Radioactivity of the suspended fraction ranged from less than 1 to 17 pCi/liter and averaged less than 1. Radioactivity of the soluble fraction ranged from less than 1 to 10 pCi/liter and averaged 1.8. Average beta radioactivity of the Columbia below Hanford ranged from 5 to 308 pCi/liter. Phosphorus-32 concentration ranged from less than 1 to 360 pCi/liter. Gamma emitters ranged from less than 50 to 127 pCi/liter for ruthenium-106, less than 5 to less than 20 for zirconium-95, less than 100 to 8,458 for chromium-51, and less than 20 to 466 for zinc-65. (Knapp-USGS)
W69-00916

INSECTICIDE ADSORPTION BY LAKE SEDIMENTS AS A FACTOR CONTROLLING INSECTICIDE ACCUMULATION IN LAKES,
Wisconsin University, Madison, Soils Dept.
G. Chesters.
Rep of Phase 2 of project. Rep of Office of Water Resources Res, Wis Univ, Madison. 14 p, 4 tab, 4 fig, 2 attach. August 1968, OWRR Project B-016-Wis.

Descriptors: *Insecticides, *Adsorption, *Lakes, *Sediments, Clays, Organic matter, Chemical degradation, Hydrolysis, Pesticide kinetics, Methodology.
Identifiers: Malathion, Parathion, Lindane.

Investigation of the adsorption of insecticides on lake sediments as a factor controlling insecticide accumulation in lakes is reported. Reprints of 2 Journal papers are attached to and form a part of this report; one describes a quantitative method for unified extraction of organochlorine and organophosphate insecticides from lake waters and the other reports on determination of lindane adsorption on 8 intact lake sediments using a radiochemical technique. Methods developed for extraction and analysis of insecticides ranged in effectiveness from 81-88% for heptachlor to 93.9-102.4% for most other commonly used insecticides. Lindane adsorption was affected by suspended sediment concentration, organic content, lindane concentration and clay content. Adsorption is decreased in the presence of iron oxides, possibly because oxide coatings on clay particles interfere with surface OH bonding. Adsorption in separate sediment fractions decreases with increasing particle size. Malathion adsorption is largely controlled by organic content of sediment. In separate sediment fractions, however, malathion adsorption decreased with increasing particle size and iron oxide content. Lindane degradation is faster under anaerobic than aerobic conditions. Parathion decomposes by hydrolysis in a first-order reaction with a half-life of about 50 hours. (Lang-USGS)
W69-00921

GROSS RADIOACTIVITY IN SURFACE WATERS OF THE UNITED STATES, FEBRUARY 1968.
Division of Pollution Surveillance, Federal Water Pollution Control Administration, Washington, D. C.

Radiol Health Data and Rep, Vol 9, No 8, pp 436-437, Aug 1968. 2 p, 1 fig, 1 tab, 7 ref.

Descriptors: *Data collections, *Radioactivity, *Monitoring, *Surface waters, Water quality, Radiochemical analysis.

The data obtained in the monitoring of levels of radioactivity in surface waters of the U S in Feb 1968 are tabulated. The radioactivity of dissolved solids alone roughly indicates levels in treated water because nearly all suspended matter is removed in treatment. Strontium-90 results are reported semi-annually. Special note is made when alpha radioactivity concentration is 15 pCi/liter or more and when beta radioactivity concentration is 150 pCi/liter or more. In Feb 1968, the Arkansas River at Coolidge, Kansas, the North Platte at Henry, Nebraska, and the South Platte at Julesburg, Colorado exceeded 15 pCi in alpha radioactivity concentration. (Knapp-USGS)
W69-00933

THE ANALYSIS OF AROMATIC COMPOUNDS IN WATER USING FLUORESCENCE AND PHOSPHORESCENCE.
New Hampshire Univ, Durham.
David W. Ellis.
Prog Rep, Phase I, 1968. 24 p, 1 fig, 1 tab, 21 ref.
OWRR Project A-009-NH.

Descriptors: *Aromatic compounds, *Water analysis, Chemical analysis, Gas chromatography, Spectrophotometry, *Spectrometers, Fluorescence, *Fluorometry, Temperature, Instrumentation, Aromatic solvents, Chromatography.

The paper is a progress report covering the first phase of an investigation using a commercial spectrofluorometer/spectrophosphorim eter for analyzing aromatic compounds in water. The object of the investigation is to develop a basic method for analysis of aromatic compounds. Pesticide analysis Grade n-pentane was selected as the solvent for extraction. The report covers: Extraction and concentration, column chromatographic removal of basic components, thin-layer chromatographic separation and identification, fluorescence analysis, gas chromatographic analysis, mass spectrometer, and nitromethane extraction. Planned research for the remainder of the first phase is given.
W69-01114

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VIRUS INACTIVATION ON CLAY PARTICLES IN NATURAL WATERS,
Metcalf and Eddy, Boston, Mass, and Maine Univ., Orono.
George F. Carlson, Jr., Franklin E. Woodard, and David F. Wentworth.
Supported in part by U S Dept of the Int, WRA 1964 and FWPCA Grad Tr Grant and Res Grant. J Water Pollut Contr Federation, Vol 40, No 2, Part 2, pp R89-R106, Feb 1968. 18 p, 9 fig, 10 tab, 19 ref. OWRR Project A-004-ME.

Descriptors: *Water pollution, *Viruses, Aquatic microbiology, Clays, Suspension, Turbidity.
Identifiers: *Virus inactivation, Adsorption virus.

Research was conducted on the inactivation of viruses in clay particles suspensions as affected by various conditions found in natural streams. Of special interest were the primary inactivation mechanism, the effect of varying ionic strength with different clays, and the effect of organic macromolecular substances on inactivation. Viruses used in research were: bacteriophage T2, against Escherichia coli strain B, and type 1 poliovirus. The poliovirus was titered by the plaque technique. All clay particles were centrifuged from the observed virus inactivation. To evaluate the applicability of these basic research results to the natural situation, natural river turbidity collected from the Missouri River was resuspended in tapwater and experiments were conducted with varying amounts of calcium chloride. The effects of centrifugation to remove clay particles are discussed. Among the many experimental findings listed, it is stated that the adsorption of virus only clay particles was proven to be reversible; thus, viruses absorbed onto clay are inactivated only temporarily. (Llaverias-USGS)
W69-01185

5B. Sources of Pollution

THE MOVEMENT OF RADIONUCLIDES THROUGH SOIL FORMATIONS,
Iowa State Univ., Ames.
Charles A. Qulman, and Lyle V. A. Sendlein.
Eng Res Inst Rept, Jan 1968. 27 p, 12 fig, 1 map. OWRR Project A-011-Ia.

Descriptors: Geologic mapping, *Radioisotopes, Soil physical properties, *Tracers, Subsurface investigations, *Radioactive wastes, Radioactive waste disposal, Geologic investigations, Foundations, Permeability, Seepage, Adsorption.

A study was made on the site of the Ames Laboratory Research Reactor to gather basic information needed in planning future field studies concerned with the movement of radionuclides through soil. Soil and bed rock in the area were mapped by outcrop studies and by electroresistivity and seismic measurements. Six bore holes were drilled to provide control for indirect geophysical measurements. The physical properties of soils from the B-horizon and from a gully used for waste water disposal were investigated. Tracer studies were made on disturbed and undisturbed soil samples in the laboratory by percolating spiked solutions through soil columns to determine the uptake of strontium and cesium. Batch tests were also made to develop the adsorption isotherms of the soil for strontium and cesium.
W69-00708

VIRUS INACTIVATION IN NATURAL WATERS. 1. VIRUS INACTIVATION ON CLAY PARTICLES,
Maine Univ., Orono.
G. F. Carlson, Jr., F. E. Woodard, and O. J. Sproul.

39th Annu Conf, Water Pollut Contr Fed, Kansas City, Mo, Sept 1966. 47 p, 9 fig, 10 tab, 19 ref. OWRR Project A-004-Me.

Descriptors: *Viruses, Microorganisms, *Bacteriophage, Biocontrol, Diseases, Microbiology, Water pollution sources, Public health, Clay.

The objective of this research was to investigate the adsorption of virus to several different types of clays. The experimental virus used was T2 Bacteriophage and the Type I Poliovirus. The maximum removal obtained using a sodium salt-clay-virus system was 99% for each of the 3 clays studied. When the clay concentration was increased, the required salt concentrations to achieve maximum removal increased correspondingly. Competition for the adsorption site by other organics was demonstrated. It was determined that naturally occurring river clays (Missouri River) showed response very similar to those of the pure clay minerals.
W69-00719

THE ION-EXCHANGE REACTIONS OF RADIOACTIVE IONS WITH SOILS AND EFFECTS OF ORGANIC COMPOUNDS,
Illinois Univ., Urbana.
Bong Taick Kown.
Dep Civ Eng Rept, Oct 1966. 150 p, 45 fig, 14 tab, 43 ref, append.

Descriptors: Ions, *Ion exchange, *Soils, Montmorillonite, Illite, Clay minerals, Adsorption, Organic compounds, *Cation exchange, Radioactive wastes, Radioactive waste disposal, *Radioisotopes, Radioactivity, Organic matter.

The ion-exchange reactions of radionuclides with soil minerals and the effects of various water soluble organic compounds on the reactions were investigated. Theories were examined for predicting equilibrium distribution of radionuclides in soils. Results show the mass-action law describes ion-exchange equilibria except in systems involving hydrogen ions. Certain organic compounds are irreversably adsorbed on soil particles which reduces effective exchange capacity and the selectivity of the exchange media.
W69-00726

WESTON DRILLING COMPANY V TUPPER (OIL LEAKAGE AND WATER POLLUTION).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00805

NO 112, AN ACT TO AMEND 10 V S A SEC 951 RELATING TO THE DEPOSIT OF SAWMILL WASTE.
Laws of Vermont 1967, No 112. 1 p.

Descriptors: *Legislation, Local governments, *Vermont, Water pollution, *Sawdust, Saw mills, *Wood wastes, Water pollution sources, Slabs, Lakes.

It is unlawful in Vermont to deposit edgings, slabs, sawdust, shavings or any other sawmill refuse in the waters of any stream, pond, reservoir, or lake or on the shore in such a manner as to be subject to being washed in the main body of water under normal high water conditions. A person who violates this statute may be fined a maximum of $100. (R. H. Watson-Fla)
W69-00899

EFFECTS OF SOLUBLE ORGANICS ON FLOW THROUGH THIN CRACKS OF BASALTIC LAVA,
Hawaii Univ., Manoa.
Kenneth Ishizaki, Nathan C. Burbank, Jr., and Stephen Lau.
Tech Rep 16, Water Resour Res Center, Aug 1967. 56 p, 38 fig, 9 tab, 42 ref, 2 append. OWRR Project A-001-Hi.

Descriptors: Percolation, Ground water, *Permeability, Porosity, Closed conduit flow, *Ground water movement, Capillary flow, *Lava, Basalts, Water pollution sources, Microorganisms, Ferrobacillus, Flow resistance, Retention, Hawaii.
Identifiers: Hagan-Poiseuille flow, Clogging.

Most of Oahu's domestic water supply is from ground water occurring in permeable materials of volcanic rock. Movement of ground water is intrinsically through thin cracks in basaltic lavas. This project studied passage of an organic-rich liquid through cracks in basalt. Permeability of blue rock portions of a basalt was determined as 2.6 by 10 to the minus 4 power gal/day/sq ft of water, classing the rock as impervious. A range of 7.7 to 10.4% in porosity values was obtained from the blue rock portions; the clinker portion yielded a value of 50%. The greatest retardation in flow of nonbiodegradable liquids through thin cracks occurred in the initial hours followed by a systematic reduction of flow to 7/8 to 1/100 of the initial flow rate. Flow of organic-rich liquids through such cracks, similar to nonbiodegradable liquids, exhibits a decrease in flow initially and continues this trend for as long as 220 hr. Terminal flow velocity of tap water is much greater than that of sewage which appears to proceed to a no-flow condition. The clogging phenomenon was dependent upon microbial activity and food supply in sewage. The products are primarily polysaccharides and slimes along with ferrous sulfide, commonly found in septic sewage in contact with soil or rock.
W69-00979

WATER QUALITY AS AFFECTED BY A WYOMING MOUNTAIN BOG,
Forest Service, Rocky Mountain Forest and Range Exper Station, Laramie, Wyo.
David L. Sturges.
Water Resources Res, Vol 3, No 4, pp 1085-1089, 1967. 5 p, 1 fig, 3 tab, 7 ref.

Descriptors: *Water quality, *Bogs, *Peat, Wyoming, Iron, Coliforms, Solutes, Silica.

Waters collected July through Oct 1965 at a Wyoming mountain bog were analyzed for potability and seasonal changes in calcium, magnesium, potassium, iron, and silica. Four locations were sampled: effluent stream, fissure locations in the bog, peat locations in the bog, and groundwater. The color and turbidity of peat water greatly exceeded that at other locations and the maximum levels established by the U S Public Health Service for drinking water. The dissolved mineral content of all waters was very low, and the waters were of excellent chemical quality. All waters contained coliform organisms, probably of a nonfecal origin in peat and fissure water. The concentration of minerals in peat water remained constant through the sampling period. Mineral concentrations in groundwater increased in Sept, when the water table was at a seasonal minimum, but decreased in Oct following water table recharge. Silica levels were higher than other ions at all locations; the highest levels were in peat water. (Author)
W69-01043

SURFACE CHLORIDE DISTRIBUTION IN MAINE LAKES,
Maine Dept. of Inland Fish and Game, Dry Mills Hatchery, Gray.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-01051

EQUILIBRIUM SURFACE WATER TEMPERATURES,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-01058

THE QUALITY OF CONNECTICUT'S SURFACE WATERS.
U S Geological Survey, Hartford, Conn.
Chester E. Thomas, Jr.
Conn Univ Inst of Water Resources Rep 6, 11 p, July 1968. 1 fig.

Descriptors: *Water quality, *Surface waters, *Connecticut, Water pollution.

Identifiers: Connecticut River, Thames River (Connecticut), Housatonic River (Connecticut).

Information on the quality of water in Connecticut streams is summarized in a lecture presented at the University of Connecticut on October 18, 1967. The chemical quality of most surface waters in the State is good. The dissolved-solids concentration generally ranges from less than 100 to about 200 ppm during low streamflow periods. Waters draining areas underlain by noncarbonate crystalline rocks or from the glacial materials derived from them are soft and low in dissolved solids. The higher dissolved-solids concentrations and harder waters occur in the western area of carbonate rocks and in the central lowland area where sedimentary rocks are dominant or where large quantities of industrial wastes are discharged to the streams. Excessive iron concentrations occur in streams at scattered locations throughout the State. Some stream water is polluted and has a high bacterial count or low dissolved oxygen content, making it unsuitable for domestic or recreation use. Pollution is most serious in the Connecticut, Housatonic, and Thames rivers. (Knapp-USGS)
W69-01060

MIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT,
Washington State Univ., Pullman.
James W. Crosby, III, Donald L. Johnstone, Charles H. Drake, and Robert L. Fenton.
Water Resources Research, Vol 4, No 5, pp 1095-1114, October 1968. 17 fig, 1 tab, 17 ref.

Descriptors: *Pollutants, Groundwater, *Infiltration, Coliforms, Enteric bacteria, Nitrates, Chlorides, *Capillary conductivity, Soil moisture.
Identifiers: Drain fields, *Test holes, Annual precipitation, Leach bed, Spokane River Valley.

A test drilling program was conducted in a drain field area of the Spokane Valley, Washington to study the movement of pollutants in glacial outwash deposits when they are subjected to extreme pollutant loads. Contrary to what might be expected, very dry soils were found at depths beneath the drain field, and it is concluded that most of the waters are being dispersed laterally by capillary mechanisms. Much of the systemic water may ultimately be returned to the atmosphere by evapotranspiration. Moisture conditions in the drain field system strongly indicate that groundwater recharge through incident precipitation in this part of the Valley would be highly improbable. Chemical pollutants are found to travel with moisture fronts, but fine materials are determined to be very effective in filtering bacteria within a relatively few feet of the leach bed. (Seneca-Rutgers)
W69-01076

A STUDY OF GROUND-WATER CONTAMINATION DUE TO OIL-FIELD BRINES IN MORROW AND DELAWARE COUNTIES, OHIO, WITH EMPHASIS ON DETECTION UTILIZING ELECTRICAL RESISTIVITY TECHNIQUES,
Ohio State Univ., Columbus.
Ronald S. Boster.
Water Resour Res, 1967. 191 p, 22 fig, 11 plate, 12 tab, 34 ref. OWRR Project A-004-Ohio.

Descriptors: *Groundwater, *Contamination, *Aquifers, *Wastes, Oil fields, *Brines, *Electrical resistivity, Saline water, Salinity Oil wastes, *Ohio, Instrumentation, Oil wells.
Identifiers: *Ground-water pollution.

During a 5-yr period after an oil boom in Morrow County, Ohio, a serious contamination of groundwater aquifers occurred because of the lack of necessary conservation efforts. Millions of gallons of oilfield waters were disposed of through unlined bulldozed pits and truckloads of brine were dumped into Shaw and Whetstone Creeks, the 2 main effluent streams traversing the major production area. A study was initiated to determine the sources, severity, areal extent, and future movement of polluted ground water. This study established the importance of the ion-exchange phenomena, which may greatly extend the time period required for natural clearing of an enclave. Resistivity studies were very effective in detection of contaminated ground waters and reinforced the above contention. Practical application of resistivity shows it can be a valuable investigative and diagnostic tool in ground-water pollution and has a decided advantage over chloride and conductivity analysis in that fewer observation wells are required.
W69-01119

ROLE OF CERTAIN STREAM-SEDIMENT COMPONENTS IN RADIOION SORPTION,
U S Geological Survey.
For primary bibliographic entry see Field 02K.
For abstract, see .
W69-01176

5C. Effects of Pollution

WATER QUALITY ALTERATION THROUGH ACID AND HEAT POLLUTION IN A 1500 ACRE RESERVOIR,
Missouri Univ., Columbia.
Robert S. Campbell, James R. Whitley, and Edward R. Brezina.
Water Resour Res Center Proj Rep 1, Mar 1966. 33 p, 8 fig, 9 tab, 1 ref. OWRR Project A-004-Mo.

Descriptors: Water quality, *Water pollution, Turbidity, Heated water, Mine acids, Fly ash, Plankton, Aquatic life, Alkalinity, pH, Animals, *Fishkill, Acidity, Hydrogen ion concentration, *Thermal pollution, Industrial wastes.

An investigation was made to evaluate the influence of several effluents on water quality, the biota, and the autotrophic aspects of community metabolism. Certain physical and chemical conditions vary throughout the reservoir in a pattern related to the site of hot water discharge. The most conspicuous environmental variant is water temperature, which ranges from 37 deg C at the steam plant discharge canal to 21 deg C at the western end of the lake. Dissolved oxygen range was 0.2 to 11.0 ppm, with the lower values from the deeper more stagnant water at the eastern and western ends of the lake. No evidence was found of alkaline drainage into the reservoir. At the time of reported fish kills, 1962-63, fly ash was piled adjacent to the reservoir. Fly ash is now stored in bins protected from the weather. Preliminary inspection of the plankton and bottom fauna suggests that the fauna is not rich.
W69-00735

INHERENT AND MAXIMUM MICROBIOLOGICAL ACTIVITY IN SMITH LAKE,
Alaska Univ., College.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-00744

JACKSON V ATLANTIC COAST LINE R R (RIPARIAN'S RECOVERY FOR POLLUTION).

317 F 2d 95 (4th Cir 1963).

Descriptors: Oil wastes, *Nuisance (Water law), Judicial decisions, *Remedies, Riparian land, Pollution (Stream), South Carolina, Railroads.
Identifiers: Damages (Exemplary), Negligence.

Oil spillage from a railroad yard was discharged into an adjacent ditch which in turn emptied into a stream. The waste was carried downstream and washed upon the land of a lower riparian owner resulting in appreciable damage. The owner sued the railroad on the theory of negligence and was awarded compensatory and punitive damages. The railroad appealed the award of punitive damages alleging plaintiff's failure to prove negligence. This court affirmed the decision of the trial court, holding that the precipitation of oil upon the riparian owner's land was a continuing nuisance entitling him to recover damages without proof of negligence. Moreover, the continuation of the deposits despite repeated complaints by the owner was ample support for the award of exemplary damages. (Geraghty-Fla)
W69-00835

THE ECOLOGICAL SIGNIFICANCE OF CELLULOLYTIC BACTERIA IN QUABBIN RESERVOIR,
Clark Univ., Worcester, Mass.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-00976

FISH KILLS BY POLLUTION, 1966: SEVENTH ANNUAL REPORT.

Fed Water Pollut Contr Admin, Publ No CWA-7, 1967, 17 p, 11 tab, 4 rep.

Descriptors: *Fishkill, Water pollution effects, Fish conservation, Aquatic environment, Industrial wastes, Municipal wastes.

An estimated 9,115,000 fish were reported killed by identifiable pollution sources in 46 States during 1966. There were 95 other reports of fish kills in which pollution was suspected by the source could not be definitely determined. The total of reported kills is 2,500,000 less than in 1965 when 44 States reported kills of 11,784,000. The decline may have been actual or it may have been due to variations in reporting between the two years. The average number of kills was greater in 1966 than in 1965. The two worst cases of fish kills in 1966 - one million each - were caused by two of the most difficult problems facing pollution control experts - mine drainage and over-enrichment of water by municipal and other wastes. The annual fish kill census is gathered through the cooperation of individuals, State fish and game agencies, and water pollution groups.
W69-01123

MANIPULATION OF RESERVOIR WATER FOR IMPROVED QUALITY AND FISH POPULATION RESPONSE,
Wisconsin Conser Dep Water Resources Res Sect, Madison.
Russel C. Dunst.
Wis Conserv Dep Impoundment Stud Proj Annu Progr Rep 1966, 9 p, 1966. 88 tab. OWRR Project B-004-Wis.

Descriptors: *Data collections, *Impoundments, *Water quality, *Biological properties, *Stratification, Eutrophication, Temperature, Water circulation, Mixing, Fish, Wisconsin.

Water management techniques for impoundments are being studied to determine their effects on water quality and fish populations. The biological and environmental factors being studied include water temperature, dissolved oxygen concentration, nutrient content, water clarity, the composition and density of the bottom organism population, and several parameters of the fish population. The Cox Hollow Lake artificial circulation experiment was of primary interest during 1966. An Aero-Hydraulic System was installed on July 1, 1966; the impoundment, the inlet streams, and the discharge waters were studied before and after installation of the system. The severe stratification, present before circulation was operated, did not appear. Only a 6 deg difference between top and bottom water developed, and surface water temperature never exceeded 78 deg, which is estimated to be 7-8 deg below normal. Dissolved oxygen was present at the bottom for the first time. Algae blooms did not occur. Nutrient concentrations decreased. (Knapp-USGS)
W69-01170

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5D. Waste Treatment Processes

ANNOTATED BIBLIOGRAPHY - TEXTILE WASTES,
North Carolina Univ., Raleigh.
Harley Y. Jennings.
Water Resour Res Inst Rep 1966. 68 p, 297 ref. OWRR Project A-016-NC.

Descriptors: *Textiles, Water pollution sources, Waste treatment, Waste disposal, *Bibliographies, Water pollution, Pollution abatement, Oxidation, Waste water treatment, *Wastes, Waste identification, Industrial wastes, *Textile industry.
Identifiers: Waste management.

In May 1965, a feasibility study concerning the recovery of wastes from the desizing of fabrics as an approach to the alleviation of stream pollution by textile processing operations was initiated. It was the objective initially to examine the possibilities of recovering existing sizes, and examine the possibilities of using materials of known ease of recovery from aqueous solution as possible sizes. A search of the chemical literature concerning warp-size wastes, as well as other sources of pollution from textile mills was made. This annotated bibliography has been key-word coded and indexed to aid in retrieval of this information. The coding, whenever possible, was done according to the Thesaurus of Engineering Terms published by the Engineering Terms published by the Engineers Joint Council.
W69-00711

INFILTRATION AND PERCOLATION OF SEWAGE THROUGH OAHU SOILS IN CESSPOOL LYSIMETERS,
Hawaii Univ., Honolulu.
Melvin K. Koizumi, Nathan C. Burbank, and L. Stephen Lau.
Tech Rep 2, Aug 1966. 49 p, 18 fig, 6 tab, 25 ref, 4 append. OWRR Project A-001-Hi.

Descriptors: *Infiltration, *Percolation, *Sewage, Sewage disposal, pH, Sewage treatment, Soils, Lysimeters, Oxidation, Flow nets, Laboratory tests, Soil physical properties, Permeability, *Cesspools.
Identifiers: Oahu, Hawaii.

This study investigated conditions contributing to cesspool failure and followed selected parameters to measure the degree of treatment afforded sewage in cesspool disposal. This laboratory study utilized bench scale soil lysimeters and 2 basic soil types: the Wahiawa Low Humic Latosol and the Lolekaa Humic Latosol. A 99% reduction of the infiltration rate was evidenced by the Wahiawa soil over the experiment-period of 30 to 40 days. Both sewage-fed lysimeters containing the Low Humic Latosol developed a panlike layer of soil fines approximately 3 cm below the bottom of the cesspools, preventing the penetration of suspended solids after 7 days. The Lolekaa soil did not show such changes. Flow nets plotted from pressure readings of the Wahiawa Low Humic Latosol showed that clogging occurred in the 8 to 10-cm zone of the side wall and the soil base of the lysimeters containing this soil. Flow through the lysimeter was governed by infiltration, rather than percolation. The results of this experiment indicate that unless further degradation of the effluent is effected by the soil mass, incomplete degradation of the sewage makes it a definite hazard to groundwater sources. This study presents soil-effluent interraction at a 1-ft depth.
W69-00714

PRELIMINARY DESIGN AND SIMULATION OF CONVENTIONAL WASTEWATER RENOVATION SYSTEMS USING THE DIGITAL COMPUTER,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
For primary bibliographic entry see Field 06C.
For abstract, see .
W69-00926

WATER SUPPLY AND POLLUTION CONTROL ASPECTS OF URBANIZATION,
Duke University, Department of Civil Engineering.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00963

ELECTRODIALYSIS IN ADVANCED WASTE TREATMENT.
Cincinnati Water Research Laboratory, Robert A Taft Sanitary Engineering Center), Ohio.
J. Douglas Smith, and John L. Eisenmann.
Fed Water Pollut Contr Admin, Publ WP-20-AWTR-18, Feb 1967. 219 p, 32 fig, 42 tab, 3 chart, 19 ref, 5 append.

Descriptors: *Tertiary treatment, *Electrodialysis, Demineralization, Economics, Membrane.
Identifiers: Wastewater renovation, Deionization.

A bench-scale experimental study was made to determine the practicality of partially demineralizing municipal waste water by electrodialysis. Using filtration alone and filtration followed by carbon adsorption as pretreatments, long term runs were made with a municipal secondary effluent to determine scaling and fouling effects of the water upon the electrodialysis membranes. During these runs a study was made to determine how high a ratio of product rate to concentrate rate could be obtained without forming scale on the membranes. Some fouling of anion membranes occurred with filtration and carbon adsorption pretreatment; without carbon adsorption, fouling was much worse. Scale formation was not a problem at product to concentrate ratios less than ten. At times much higher ratios were obtained without difficulty. The results of these runs indicated that the total operating cost for a 10-mgd electrodialysis treatment plant might be less than 10 cents per 1,000 gal. Information is presented on the relative selectivity of the membranes for the common ions in waste water. Included are data on the long term runs in which actual waste water was used, and some data on laboratory prepared solutions.
W69-01127

SUMMARY REPORT ADVANCED WASTE TREATMENT PROGRAM, JULY 1964-JULY 1967,
Fed Water Pollut Contr Admin, Cincinnati, Ohio.
Robert A. Taft.
Fed Water Pollut Contr, Res Ser Publication WP-20-AWTR-19, 96 p, 1968. 36 fig, 17 tab, 24 refs.

Descriptors: *Wastewater treatment, *Tertiary treatment, *Activated carbon, *Electrodialysis, *Ion exchange, *Reverse osmosis, Ultimate disposal, Cost analysis, Economic feasibility, Technical feasibility, Research and development.
Identifiers: Clarification, Advanced waste treatment, Nutrient removal.

Results of waste-treatment studies from 1964-67 are summarized. The treatment methods studied include solids removal, organic removal, inorganic removal nurtient removal, and ultimate disposal. Lime clarification, which removes suspended solids and dissolved phosphates, is also used in potable water supply systems and is economically favorable. Alum clarification should be successful at a cost of 8 cents per 1,000 gals. Activated, granular, and powdered carbon treatment should cost 8-12 cents per 1,000 gals if the carbon can be reactivated. Electrodialysis should cost 16 cents per 1,000 gal if fouling of membranes is eliminated by pretreatment of influent. Ion exchange and reverse osmosis should be competitive with electrodialysis. Nitrogen removal is a difficult problem, for which air-stripping of ammonia appears feasible and should not cost over 2 cents per 1,000 gals. Highly nitrified activated carbon or liquid effluent shows promise for ultimate nitrate removal. Knapp-USGS)
W69-01169

5E. Ultimate Disposal of Wastes

DISPOSITION AND CONTROL OF URANIUM MILL TAILINGS PILES IN THE COLORADO RIVER BASIN.
Federal Water Pollution Control Administration, Denver, Colo.

Fed Water Pollut Contr Admin Rep, Mar 1966. 36 p, 3 tab, 38 photo, 18 ref.

Descriptors: *Ultimate disposal, *Colorado River Basin, Waste dumps, Waste disposal, Mine wastes, Bibliographies, *Radioactive waste disposal, Water pollution.
Identifiers: *Uranium mill tailings.

This report on the disposal and control of uranium mill tailings piles in the Colorado River Basin reflects the concern of the Federal Water Pollution Control Administration with all aspects of the various radiochemical waste sources which have a potential for pollution of Colorado River Basin waters. The purpose of this report is to evaluate the radioactivity content of uranium mill tailings piles in the Colorado River Basin, to evaluate their radioactivity water pollution potential insofar as this is possible, and on a case by case basis, to indicate feasible and desirable remedial measures for controlling and limiting the spread of radioactivity from the piles.
W69-01122

5F. Water Treatment and Quality Alteration

INFLUENCE OF TURBULENCE ON SURFACE REAERATION,
Illinois Univ., Urbana.
E. R. Holley, and K. K. Klintworth.
Water Resour Center Rept, Sept 1966. 42 p, 9 fig, 1 tab, 11 ref. OWRR Project A-001-Ill.

Descriptors: *Turbulence, *Reaeration, Flow characteristics, Analysis, *Oxygenation, Temperature, Time, Diffusion, Anemometers, Calibrations, Instrumentation, Heat transfer, Experimental data, *Water purification, Water treatment, Water pollution control, Water quality control, Hot film anemometers.

Some numerical methods are described for determining vertical diffusion coefficients as a function of vertical coordinate in a turbulence vessel where there are no net velocities. It is planned to use this turbulence vessel and these numerical methods to study in detail the mechanics of diffusion of a substance (analogous to oxygen) which is absorbed at the free surface. A hot-film anemometer is to be used to make direct measurement of turbulence parameters affecting the diffusion process. The anemometer has been calibrated in water which was in solid body rotation. Some of the difficulties experienced with the hot-film sensor and corrective measures used are discussed. Preliminary diffusion tests have been made in the turbulence vessel where turbulence is generated by vertically oscillating screens made of expanded metal. Some values of the vertical diffusion coefficient have been calculated from the data for 2 of these preliminary runs. Plans call for more detailed diffusion studies and for making direct turbulence measurements in studying surface reaeration.
W69-00728

DRINKING WATER ANALYSIS PROGRAM, 1961-1966,
National Center for Urban and Industrial Health and National Center for Radiological Health, Washington, D. C.

Radiol Health Data and Rep, Vol 9, No 8, pp 442-448, Aug 1968. 2 tab, 6 ref.

Descriptors: *Data collections, *Radioactivity, *Potable water, *Water quality, Radiochemical analysis.
Identifiers: Drinking water standards.

Radioactivity concentrations of public drinking water supplies of about 800 communities in the U S are tabulated and standards are briefly outlined. The analyses were of samples collected between 1961 and 1966. They include Dr-90, dissolved alpha radioactivity, suspended alpha radioactivity, dissolved beta radioactivity, and suspended beta radioactivity. The drinking water standards for radionuclides are conservative in their requirements. The standards provide for the approval of water supplies, based on their radionuclide content, when the water does not contain more than 3 pCi/liter of radium-226 or 10 pCi/liter of strontium-90. In the absence of strontium-90 (much less than 10 pCi/liter), and in the absence of alpha emitters (much less than 3 pCi/liter), the water supply is acceptable when the gross beta concentration does not exceed 1,000 pCi/liter. However, a water supply may be approved when the limits prescribed above are exceeded if it can be demonstrated by surveillance that the total intake of radioactivity from all sources is within the guidance recommended by the Federal Radiation Council for control action. When mixtures of radionuclides are present, the relative contribution of each radionuclide to the total intake of the individual should be considered when evaluating the exposure. (Knapp-USGS)
W69-00914

REMOVAL OF COLOR FROM SOUTH KOHALA WATER: HAWAII,
Hawaii Univ., Manoa.
Nathan C. Burbank, Jr., Po Lau Chan, and Reginald H. F. Yound.
Tech Rep 14, Water Resour Res Center, Aug 1967. 22 p, 8 fig, 4 tab, 24 ref. OWRR Project A-013-Hi.

Descriptors: Water quality control, *Water purification, Coagulation, Zeta potential, Plant pigments, Water pollution effects, Chemical precipitation, Surface waters, Humic acids, Water treatment, Filtration, *Color, Physical properties, *Water quality, Colloids, Refractivity, Ion exchange.
Identifiers: Peptization.

The waters of the streams in the South Kohala district, on the island of Hawaii, have long been noted for extremely high color and a distinct peaty taste. Early attempts at treatment revealed that color bodies occurring in the water were refractive in nature and difficult to remove. At the end of 1 yr of research into the problem of removal of color from water, it has been found that color bodies are predominantly organic and characteristic of humic and tannic acids of vegetable origin. Color of the water has varied from a maximum value of 320 units to a minimum value of 22 units, the average is 80 units. Zeta potential of the color colloid complex has varied from 36 mv to 18.5 mv. Coagulation and removal of the color can be achieved using alum or ferric sulfate. Alum with an average dosage of 25 mg/1 can reduce color level from 140 to as low as 10 mg/1 while ferric sulfate at an average dosage of 20 mg/1 can reduce color level of water to as low as 5 color units over a wide range of pH values (6.0 to 8.5). Such color reduction permits water to meet the Public Health Service standards for interstate carriers. The use of coagulant aids holds great promise for successful color removals at lower coagulant dosage.
W69-00983

THE FORMALDOXIME DETERMINATION OF MANGANESE,
Mine E. Enginun, and Robert S. Ingols.
Pap, Ga Acad Sci Conf, Statesboro, Ga, Apr 1966. 5 p, 3 fig, 2 ref. OWRR Project A-0050Ga.

Descriptors: Potable water, *Colorimetry, Chemical analysis, *Water treatment, Bacteria, Bactericides, Biological propeties, *Manganese.
Identifiers: Reproducibility, Formaldoxime procedure.

This paper reports on studies with the formaldoxime procedure for determining manganese. For research only pure samples of manganic oxide have been in contact with the bacterial culture medium so that no interference from iron has been encountered but an evaluation has been made on effects of cyanide in manganese color density. For very small quantities of manganese the formaldoxime procedure of Siders may be modified to give good reproducability by eliminating cyanide (when there is no iron present in the samples tested) and gum Ghatti if the absorbance is measured with half an hour. One drop of 5% freshly prepared peptone solution is recommended when more time is needed before optical density readings are taken or when cyanide is used to reduce iron interference.
W69-00987

FLOOD HAZARD PERCEPTION IN THE PAULINS KILL VALLEY, WARREN COUNTY, NEW JERSEY,
Rutgers-The State Univ., Newark, N. J., Geography Dept.
Jacquelyn L. Beyer.
NJ Water Resour Res Inst, Res Proj Tech Completion Rep, Oct 1967. 30 p, 4 fig, 10 tab, 25 ref. OWRR Project B-007-NJ.

Descriptors: *Attitudes, *Behavior, *Channel improvement, Control, *Decision making, *Delaware River, Federal Government, Flood control, Flood damage, *Flood plain insurance, *Flood plains, Flood protection, *Flood plain zoning, *Floodproofing, *Floods, *Floodways, *New Jersey, Planning, Regulation, Social aspects, Urbanization, Local governments.

The purpose of the project was to examine assessment of flood hazard by occupiers of a flood plain in a small town on a tributary of the Delaware River. The basis for the study was the assumption that the technical assessment of the hazard would differ considerably from the users' perception and that the difference can be clarified by systematic investigation through interviews and questionnaires. In addition to questionnaires, field work for mapping and consultation with technical experts was carried out. Quality of the data obtained was satisfactory and meaningful conclusions with respect to general land-use planning problems offered. The article prepared for publication and based on this research should be helpful in providing some guidelines for individual and public decision making. This is especially so as the pace of urbanization increases in the region in which the study town is located.
W69-00991

5G. Water Quality Control

BEHAVIOR OF SELECTED PESTICIDES WITH PERCOLATING WATER IN OAHU SOILS,
Hawaii Univ., Honolulu.
Marshall A. Eto, Nathan C. Burbank, Jr., and Howard W. Klemmer.
Tech Rep No 9, Aug 1967. 35 p, 16 ref, 6 tab, 41 ref. OWRR Project A-001-Hi.

Descriptors: *Pesticides, *Percolation, Pesticide kinetics, *Pesticide removal, Adsorption, Waste assimilative capacity, Organic pesticide, Infiltration, Ion transport, Path of pollutants, Lysimeters, Soil contamination effects, Clay loam, *DDT, Absorption, Volatility, Leaching, Organic matter, Organic wastes.
Identifiers: *Lindane.

This study investigated the ability of 2 Oahu soils, Wahiawa and Lahaina, to prevent chlorinated hydrocarbon pesticides, DDT and Lindane, in acetone solutions from percolating through soils. Wahiawa and Lahaina soils were effective in withholding DDT under saturated and intermittent flow conditions. Breakthrough of Lindane was noted in Wahiawa and Lahaina soil under saturated flow and under intermittent flow conditions in Wahiawa soil only. Breakthrough concentrations were generally in the order of 0.3 ppm or lower. Breakthrough of Lindane and concentrations in the percolant were in direct proportion to soil volume. Column analysis showed that, in most cases, Lahaina soil held both pesticides in the upper 3 in. while Wahiawa soil held only DDT in the same region. Lindane was evenly distributed through the Wahiawa columns with a slightly greater amount held at the surface. Five Oahu soils tested to determine their ability to sorb pesticides from water-acetone solutions effectively removed pesticides in solute concentrations up to 100 ppm. DDT and Lindane were removed in the order of 90 to 100% by swirling the soils in the pesticide solutions. No desorption occurred with water, but both pesticides were desorbed with benzene.
W69-00713

PREDICTION OF BEGINNING AND DURATION OF ICE COVER,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 02C.
For abstract, see .
W69-00715

DECONTAMINATION OF RADIOACTIVELY CONTAMINATED WATER BY SLURRYING WITH YZAOO AND ZILPHA CLAYS,
Mississippi State Univ., State College.
William A. Goldsmith.
Dep Civ Eng Pap, Jan 1966. 74 p, 16 fig, 13 tab, 51 ref. OWRR Project A-004-Miss.

Descriptors: *Radioactive waste disposal, Nuclear wastes, *Radioactive wastes, Radioactivity, Radioisotopes, *Adsorption, *Clays, Colloids, Cation exchange, Montmorillonite, Kaolinite.
Identifiers: Double layer.

The benefits derived from the advancing use of nuclear technology have been accompanied by problems which have never been encountered before. One main problem to nuclear industry is waste disposal. A review of the available literature reveals that some natural clays possess the ability to adsorb radioisotopes. Chemical and mineralogical properties of Yazoo and Zilpha clays suggest they might be useful as adsorbers of radioisotopes. This investigation was made to determine whether Yazoo and Zilpha clays are useful adsorbers of 3 radioisotopes: cobalt 60, stronium 90, and cessium 137. This was accomplished by slurrying a mixture of radioisotopes and tap water with varying dosages of Yazoo and Zilpha clays. Results obtained suggest that Yazoo clay is an effective adsorber of each radioisotope tested. No generalization can be drawn from results obtained concerning effectiveness of each clay for all radioisotopes, therefore, these results should be used as the basis for further investigation.
W69-00727

THE LAW OF WATER POLLUTION CONTROL,
Mississippi State Univ., State College.
P. H. Williams, L. L. McDougal, and William M. Champion.
Water Resour Res Inst Tech Rep, 1967. 18 p. OWRR Project A-014-Miss.

Descriptors: *Legal aspects, Federal government, Political aspects, State governments, State jurisdiction, Water quality control, Mississippi, Compatibility, Legislation, *Pollution abatement, *Water pollution control.
Identifiers: Water Quality Act, 1965.

The objectives of this study were to assess the present legal prescriptions relating to water pollution in Mississippi, compare these prescriptions with the Federal standards, and prepare legislation and regulations necessary to harmonize the law of this State with such Federal standards. The

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research under this project pursued a comprehensive examination of the problems relating to water pollution and governmental efforts to control such pollution. In analyzing the problems presented, the study first considered broad questions involving desirability of state versus Federal control of water quality. Study then was directed to requirements of Federal statute and guidelines, the Mississippi pollution control scheme prior to enactment of the Federal Act, and the new Mississippi water quality control law. The study then considered the Mississippi Air and Water Pollution Control Act to determine its compliance with Federal requirements, and concluded with desirable recommendations and alternatives.
W69-00733

POLLUTION OF WATERS.

Fla Stat 387 (1967).

Descriptors: Florida, *Legislation, *Underground streams, *Water pollution, Lakes, Rivers, Ditches, Streams, Cities, Septic tanks, Sewage disposal permits, *Surface-groundwater relationships, Surface waters, Drainage effects, Drainage water.

This chapter of the Florida Statutes is primarily concerned with the pollution by sewage of the underground waters of the state. It also covers pollution of lakes, rivers, streams, and ditches. It further requires that where septic tanks are used that they conform to FHA requirements. The statute provides that violations shall generally be punished as misdemeanors, although there are variations in fines according to the section violated. The State Board of Health is responsible for supervision of this act. In addition to fine and imprisonment, injunctions are available where appropriate. (Crabtree-Fla)
W69-00763

PRESIDENT'S MESSAGE ON CONSERVATION AND WATER MANAGEMENT,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00770

GARBAGE DISPOSAL AND WASTE ALONG STREAMS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00771

FEDERAL POLLUTION CONTROL,
H. W. Poston.
American Water Works Ass'n Jour, Vol 58, No 9, pp 1108-1112, Sept 1966. 5 p.

Descriptors: *Water pollution, Pollution abatement, *Federal project policy, Federal government, Sewage treatment, Water quality control, River basins, *River basin development, Research and development, Federal budgets.

The Federal Water Pollution Control Act as amended by the Water Quality Act of 1965 established a Federal Water Pollution Control Administration. This agency was transferred from the Dept of Health, Education and Welfare to the Dept of the Interior in 1966. The expanded Federal Water Pollution Control Program includes six main activities: (1) aid to communities for waste treatment -- the federal government can pay up to $1,200,000 for a single project and $4,800,000 for a multi-municipal project; (2) enforcement -- if pollution from one state endangers another, the Secretary of the Interior can take action to abate the pollution; (3) research -- the federal government is building twelve new laboratories for studies in renovating waste water; (4) river basin programs - there are projects in ten major basins at present with plans for programs in all this country's major basins. The government has set up water quality standards for water users. Standards are set by the federal government only after states have failed to established their own. Finally the federal government provides scientists and engineers to states and industries for technical assistance. New bills are being introduced, including a $6 billion program for sewer works construction and a pollution control bill under a river basin approach. (Kahle-Fla)
W69-00772

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, DEPARTMENT OF THE INTERIOR.
18 CFR Ch 5 Sec 601.0-601.25 (1968).

Descriptors: *United States, Legislation, *Grants, *Water pollution treatment, *Sewage treatment, Sewers, Public benefits, Navigable waters, Treaties, Public health, Wages, Projects, Water supply, Conservation, Regulation, Administration, Administrative agencies.
Identifiers: *Federal Water Pollution Control Act, FWPCA.

The Act establishes grants for states and interstate agencies for the prevention and control of water pollution. The requirements for and the methods of making the grants are provided. A plan must be submitted to the Commissioner in applying for a grant. The Act also provides: (1) the formula for determining payment amounts; (2) the factor's used by the Commissioner in determining the desirability of treatment works projects; and (3) the criteria for considering the propriety of federal aid. All applicants must insure certain described labor standards by providing for them in contracts for project work. Subpart C provides for grants to demonstration projects for the control of discharges from stormwater or combined sewer systems. The requirements and regulations for these grants are described. Subpart D provides for grants to qualifying research, training or demonstration projects. Grants for fellowships for research, of the causes, prevention and control of water pollution are established. The Secretary of the Interior may certify facilities under Section 48 (h) (12) of the Internal Revenue Code as being within the requirements for water pollution control under the listed standards. Public hearings are provided for. (Childs-Fla)
W69-00776

APPLICATION OF CITY OF JOHNSTOWN (SEWAGE DISPOSAL AND WATER POLLUTION).

12 App Div 2d 218, 209 NYS 2d 982-985 (1961).

Descriptors: Judicial decisions, *New York, *Water pollution, *Sewage disposal, Water pollution control, Streams, Sewage, Administrative agencies, Fresh water, Odor, Public health, Preferences (Water rights), Non-navigable waters, Cities, Municipal wastes, Administrative decisions.

The City of Johnstown sought review of an order of the Water Pollution Control Board requiring it to discontinue disposal of untreated sewage into a creek which had been classified to permit such use only if it did not cause a public nuisance. The court found that noxious odors emanating from the stream were caused by the city's sewage, and that this condition annoyed and endangered the comfort, repose, and health of a 'considerable number' of persons, thus constituting a public nuisance. The Board had power to classify the stream because 'waters of the state' included all fresh water in streams, public or private; thus the fact that the creek here was non-navigable and owned by private riparian owners had no effect on the Board's power to classify. The city's argument that the classification and order were an interference with a 'property right' was untenable, since such rights do not attach to the water itself, and are required to yield to public health and safety. The court confirmed the Board's order. (Smodish-Fla)
W69-00783

AN ACT RELATING TO PROTECTING SOURCE OF PUBLIC WATER SUPPLY.
Maine Public Law Ch 341 (1967).

Descriptors: *Maine, Water supply, *Cities, *Intakes, Legislation, Water quality, Regulation, Utilities, Water pollution sources, Water pollution control, Industrial wastes, Sewage, Pollution abatement.

Section 2436 of the Maine Revised Statutes is amended. Any water utility or municipality is authorized to take reasonable methods to protect its public water supply. It may enter land within 1000 feet of any lake, pond, well, spring, river or stream, from which it draws its water supply. Any health inspector or officer may order the owner of any building on such land, which has a system of drainage or sewage flowing or seeping into the source of the water supply, to remedy the situation. The order is to be written and set a time limit for compliance. This act is in no way to limit any private or special acts giving water utilities or municipalities greater powers to protect their sources of public water supply. (R. F. Williams-Fla)
W69-00792

AN ACT TO CREATE THE AIKEN COUNTY AIR AND WATER POLLUTION COMMISSION AND TO DEFINE ITS POWERS AND DUTIES.
South Carolina Laws 1967, No 221.

Descriptors: *South Carolina, Legislation, *Water quality, Water pollution control, Local governments, *Administrative agencies, Political aspects, Industrial wastes, Standards.

An eleven-member Aiken County Air and Water Pollution Commission is created. The commission is to maintain surveillance to insure a reasonable degree of purity of the county's water resources. It shall investigate the quality of water where necessary, keeping a particular watch for industrial pollution. The commission is to report and make recommendations to the county's legislative delegation. Cooperation among polluters to attempt to control pollution is encouraged. The commission is authorized to contract in connection with its duties, accept grants and gifts, and to investigate and hold hearings. This act is not to infringe on any duties of the Pollution Control Authority, and the commission's duties are intended to assist the county's legislative delegation in maintaining the health and welfare of the people of Aiken County. (R. F. Williams-Fla)
W69-00794

EXEMPTION FROM TAXATION OF AIR AND WATER POLLUTION FACILITIES.
Georgia Laws 1967, No 456.

Descriptors: *Georgia, *Air pollution, *Water pollution, Pollution abatement, *Taxes, Treatment facilities, Legislation.
Identifiers: Georgia Water Quality Control Board.

All property used in or apart of any facility installed or constructed for the primary purpose of eliminating or reducing air or water pollution, has been exempted by the State of Georgia from all ad valorem property taxes. Provided, however, such facilities have been certified as necessary and adequate for such purposes by either the Georgia Water Quality Control Board and/or the State Board of Health. (Geraghty-Fla)
W69-00824

UNITED ELECTRIC COAL COMPANIES V BROWN (INSUFFICIENT EVIDENCE OF POLLUTION DAMAGE).

354 S W 2d 502-504 (Ky 1962).

Descriptors: *Judicial decisions, *Kentucky, Soil contamination, Water pollution, *Strip mine wastes, Coal mine wastes, Water pollution sources, *Damages, Streams.

The court of Appeals of Kentucky held that evidence was insufficient to establish that creek water, allegedly contaminated by defendant's strip mining operation, was injurious to plaintiff's farm land and whether such damage was permanent. Judgment for plaintiff was reversed with instructions to enter judgment for the defendant. Plaintiff offered no direct evidence that the water flowing in the stream contained chemical properties injurious to his land or crops or that injuries, if any, were of permanent nature. His case was built on circumstantial evidence which the court found insufficient. (MacMillan-Fla)
W69-00880

AUBELE V GALETOVICH (RIGHT OF RIPARIAN OWNER TO INCREASE FLOW AND POLLUTE WATER).
165 NE 2d 683-686 (Ct App Ohio 1960).

Descriptors: *Municipal wastes, Sewage effluents, Waste water, *Septic tanks, Reasonable use, Domestic wastes, Overflow, Water levels, Drainage, Surface drainage, Drainage water, Drainage effects, *Ohio, Judicial decisions.

Village residents through whose lands a natural watercourse ran, brought an action to enjoin developers and the village from casting surface waters and septic tank effluent into the watercourse above their land. The court, affirming a judgment for the defendants, held that lower riparian owners could not obtain an injunction against development of additional reparian lots merely because of the resulting increase in the flow of the watercourse. One may obtain the right to cast sewage upon the lands of another without his consent only by purchase. Plaintiffs in this case failed to establish their claims by that degree of proof necessary for an injunction. The testimony indicated that the water emitted no offensive odor and contained no foreign matter, bacteria or e-coli in greater amounts than many other such streams. (Headley-Fla)
W69-00885

CITY OF DERBY V WATER RESOURCES COMM'N (DISCHARGE OF UNTREATED SEWAGE PROHIBITED).
172 A 2d 907-911 (Conn Sup Ct Err 1961).

Descriptors: *Connecticut, Administrative decisions, Civil law, Community development, Judicial decisions, Local government, Social needs, Sanitary engineering, *Sewage treatment, Waste water treatment, Treatment facilities, Sewage, *Municipal wastes, Sewage disposal, *Water pollution.

Plaintiff, a municipal corporation, was discharging untreated sewage into two rivers in violation of state law. The State Water Commission ordered the plaintiff to submit to the commission and the state department of health detailed plans: (1) for a system to adequately treat and collect its sewage; (2) to put the project out for bids; and (3) to complete the construction of the system, all by certain dates. The plaintiff appealed from this order but it was affirmed, holding the plaintiff's claim that the order was unrealistic for financial reasons to be without merit. The court asserted that public health cannot be endangered because of a reluctance on the part of municipal authorities to face up to a city's problems and find available means for coping with them. (S. Scott-Fla)
W69-00893

VICKERS V CITY OF FITZGERALD (WATER POLLUTION).
117 S E 2d 316-320 (Ga 1960).

Descriptors: *Water pollution, *Sewage, Public rights, Damages, *Riparian rights, Riparian land, Water law, Legal aspects, Municipal wastes, *Georgia.
Identifiers: Public nuisance.

The plaintiff brought action for damages to his lakeside resort area caused by the city's dumping of sewerage into the lake. Plaintiff's petition was held to set forth a cause of action for the recovery of damages and for the granting of injunctive relief. A lower riparian owner is entitled to have water flow upon his land in its natural state free from adulteration. Since the nuisance complained of was a continuing one, and it continued to the date of the suit, the statute of limitations did not apply. (Horner-Fla)
W69-00894

AN ACT RELATING TO THE USE OF WATER FROM BIRCH LAKE AND THE SOUTH KAWISHIWI RIVER IN CONNECTION WITH MINING.

Minnesota Laws 1967, Ch 556. 2 p.

Descriptors: *Minnesota, Mining, *Mine drainage, Administrative agencies, Water quality control, Standards, *Water permits, Flooding, Non-consumptive use, State jurisdiction, Legislation, *Withdrawal.

Copper, copper-nickel mining companies are authorized to use water from Birch Lake and the South Kawishiwi River and to flood or affect state lands adjacent thereto. Permits from the commissioner of conservation are required for withdrawals. All waters withdrawn must be returned to the same drainage basin from which they were taken, in conformity with established water quality standards. Permits from the water pollution control commission are required for construction, operation and maintenance of disposal systems. Permits are also required for flooding of state lands. (R. F. Williams-Fla)
W69-00897

AN ACT RELATING TO WATER POLLUTION CONTROL: AMENDING MINNESOTA STATUTES 1965, SECTION 115.44, BY ADDING A SUBDIVISION.
Minnesota Acts Ch 203 (1967).

Descriptors: *Minnesota, *Legislation, Administrative agencies, Federal jurisdiction, Regulation, *Standards, Water quality, State jurisdiction, *Classification.

Minn Stat Sec 115.44 (1965) is amended to authorize the water pollution control commission to waive compliance with other requirements of this section with regard to classifying waters or adopting standards if it finds such to be necessary to comply with the Federal Water Pollution Control Act or any other federal law or regulation. It is also authorized to classify waters and to adopt criteria and standards to conform to federal law, notwithstanding other provisions of Minnesota law, compliance with other requirements of this section is directed where, and as soon as, possible. The commission is also authorized notwithstanding subdivision 4, to set effluent standards, regardless of whether the waters they enter are classified or unclassified. (R. F. Williams-Fla)
W69-00898

AN ACT TO AMEND 10 V S A SECS 902 AND 909 AND 24 V S A SEC 3611 AND TO REPEAL SEC 9 OF NO 139 OF THE ACTS OF 1965 RELATING TO POLLUTION CONTROL.
Laws of Vermont 1967, No 181. 2 p.

Descriptors: Financing, *Vermont, *Legislation, Administrative agencies, *Water pollution, *Sewage districts, Classification, Recreation, Water conservation, Water control, Water purification, Water quality, Water sports, Water treatment, Disinfection, Irrigation, Filtration.

Vermont classifies its water into four groups according to possible uses. Class A is suitable for public water supply with disinfection when necessary. Its character is uniformly excellent. Class B is suitable for bathing and recreation, irrigation, and agricultural uses. It is a good fish habitat with aesthetic value. It is acceptable for public water supply with filtration and disinfection. Class C is suitable for recreational boating, irrigation of crops not used for consumption without cooking, as a habitat for wildlife, and such industrial uses as are consistent with other Class C uses. Class D is suitable for supporting aerobic aquatic life, for power, navigation, and certain industrial process needs consistent with other Class D uses. Pollution of water is prohibited in Vermont except with written authorization. The board may take action against any person who reduces a body of water from one classification to another. The duties of the sewage disposal commissioners are listed. They include the power to require any person to connect to the municipal sewage system to abate the pollution of waters. (R. H. Watson-Fla)
W69-00901

AN ACT TO AMEND 10 VSA SEC 1153 RELATING TO REPORTS OF WELL DRILLERS.
Laws of Vermont 1967. No 168, 1 p.

Descriptors: *Vermont, *Legislation, Administrative agencies, Water resources, *Water analysis, Chemical analysis, Laboratory tests, Wells, *Well regulations, Drilling.

Vermont requires all well drillers to submit to the water resources board within six months after the drilling, a report of the physical and chemical analysis of a sample of water from each well drilled. The analysis may be obtained from the state health laboratory, from private facilities with the consent of the board, or from the board itself on payment of a fee of $5.00 for each analysis made. (R. H. Watson-Fla)
W69-00902

CH 254 - AN ACT RELATIVE TO THE PREVENTION OF POLLUTION FROM DREDGING, FILLING, MINING, OR OTHER CONSTRUCTION.
Laws of New Hampshire 1967, Ch 254, 1 p.

Descriptors: *Legislation, *New Hampshire, *Water pollution, Administrative agencies, Landfills, *Dredging, Excavation, Mining.

New Hampshire amended its statute on the prevention of pollution from dredging, filling, mining, or other construction. The amended statute makes any person proposing to dredge, escavate, place fill, mine or undertake construction in the surface waters of the state directly responsible for the submission of plans concerning such proposal to the commission at least 30 days prior to undertaking any such activity. The commission's written permission to conduct such operations is required. The commission has full authority to establish the terms and conditions under which the permit may be exercised. (R. H. Watson-Fla)
W69-00907

CH 145 - AN ACT PROVIDING FOR THE PROTECTION OF THE SURFACE WATERS OF THE STATE BY PREVENTING THE DEPOSIT THEREIN OF RUBBISH AND WASTES.
Laws of New Hampshire 1967, Ch 145, 1 p.

Descriptors: *Legislation, *New Hampshire, Water pollution, Administrative agencies, *Surface waters, *Wastes, Ice, Banks, Domestic wastes.
Identifiers: Rubbish, Litter.

New Hampshire amended its general water pollution statute. The statute now makes it unlawful for any person to place any bottles, glass, crockery, cans, scrap metal, junk, paper, garbage, tires, old automobiles or parts, trees or similar litter in a surface water of the state or on the ice covering the surface water or the banks. An agent of the commission shall order immediate removal of the

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material by the violator. If the violator refuses the agent may contract to have the litter removed and the violator will be liable for the cost of the removal in an action of debt. Also any violator will be subject to a fine of not less than $25 or more than $100. (R. H. Watson-Fla)
W69-00908

ALTERNATIVE ECONOMIC RESPONSES TO THE ACID MINE DRAINAGE PROBLEMS IN APPALACHIA,
Ohio State Univ., Columbus.
Richard A. Tybout.
Water Resources Center, Feb 1968. 42 p, 3 tab, 17 ref. OWRR Project A-005-Ohio.

Descriptors: *Mine drainage, *Acid mine water, Benefit-cost ratios, Mine acids, Benefits, Costs, Indirect benefits, Coal mines, Waste disposal, Strip mine wastes, Water pollution, Water pollution sources, *Pollution abatement, *Coal mine wastes, Mathematical models, Aesthetics.
Identifiers: Appalachia, Beautification.

The study consists of a cost-benefit analysis of the pollution abatement problem from acid mine drainage. Empirical information is based primarily on experiences in Pennsylvania, the only public program for abatement in effect at the present time. Costs are found in 3 parts: (1) costs of treatment; (2) costs of sealing; and (3) secondary costs. First, employment, wage, price, and production series were constructed county-by-county to isolate effects of treatment costs on employment. Second, for generalizing costs to the states, predicting mine drainage was analyzed on the basis of (1) volume of drainage per ton of coal mined, by county, with subcases for deep and strip mining with corrections for seam thickness and hydrologic conditions; (2) quality of drainage as affected by surrounding geological strata. Benefits are found for (1) municipal water treatment; (2) industrial water usage, and (3) recreation. Aesthetic improvements are also benefits, but a method of measuring is not currently available; therefore, the level of aesthetic benefits required to offset costs was determined by difference. Secondary benefits of community impact of tourist expenditures are included. Conceptual limitations to the use of secondary costs and benefits are noted.
W69-00972

TO INVESTIGATE THE DISPOSAL OF AGRICULTURAL PRODUCT WASTES THROUGH THE SOIL,
Maine Univ., Orono.
R. V. Rourke.
Water Resour Center Term Rep R1084-3, 1967. 8 p, 2 tab, 8 ref, append. OWRR Project A-002-Me.

Descriptors: *Particle size, *Filtration, *Biochemical, *Filters, Oxygen demand, Waste water treatment, *Pollution abatement, Topsoil, Organic waste, Porous media, *Soils.

A trial was initiated to determine the ability of various soil textures to filter the waste water effluent of a potato processing plant. The filtering efficiency was based upon the biochemical oxygen demand of the water before and after passing through a 6 inch soil layer. The trial period was for 7 weeks and consisted of a weekly irrigation of 4000 ml. of waste water to 4 square feet of soil surface. As judged by reduction of the biochemical oxygen demand the filtering efficiency of loamy fine sand was greater than that of sandy loam. Silt loam had the lowest filtering efficiency. (Author)
W69-00990

TERPENES FROM SULFATE PULP MILL WASTE LIQUOR: THE PRODUCTION OF CIS- AND TRANS-CARONIC ACIDS FROM DELTA-3-CARENE,
Montana State Univ., Bozeman, Chem Eng Dept.
James H. Jarrett.
Report of Accomplishment, Dec 1967. 85 p, 28 fig, 2 tab, 22 ref, append. HEW-PHS Grant No. WP-00510-05.

Descriptors: *Pulp wastes, *Pulp and paper industry, Byproducts, Industrial production, Oxidation, Oxidation-reduction potential, Sulfates.
Identifiers: Terpenes, Turpentine, Dibasic acid.

The sole known source of delta-3-carene, a bicyclic terpene, in the United States and Canada is in the by-product turpentine produced by 5 western Kraft pulp mills. The present potential supply of delta-3-carene is 1000 gallons per day. Two cyclopropane ring-containing dibasic acids (cis- and trans-caronic acids) were recovered in 99 percent purity from the mixture of oxidation products obtained by the potassium permanganate oxidation of delta-3-carene in acetone. The yield of cis-caronic acid was 6.5 percent and the yield of trans-caronic acid was 0.5 percent. The identification of cis- and trans-caronic acid was based on commercial analysis for carbon, hydrogen and oxygen, and on infrared and nuclear magnetic resonance spectroscopy. The spectra are included in this thesis.
W69-00992

THE EFFECT OF SELECTED HERBICIDES UPON THE GROWTH OF PLANKTONIC FRESH WATER ALGAE AND THEIR PERSISTENCE IN SURFACE WATERS,
Louisiana Polytechnic Institute, Ruston, Botany and Bacteriology Dept.
Otto Wasmer, Jr.
Louisiana Water Resour Res Inst, Louisiana State Univ, Baton Rouge, May 1967. 19 p, 11 fig, 5 ref. OWRR Project A-003-La.

Descriptors: *2-4 D, *Herbicides, *Phytoplankton, *Phytotoxicity, Algal poisoning, Scenedesmus, Chlorella, *Euglena, Algal control, Bactericides, Growth rates.

The purposes of the investigation were to determine effect of selected herbicides upon the rate of growth of certain fresh water planktonic algae; to determine effect of selected herbicides upon the physiology of these algae; and to determine morphological changes in algae exposed to herbicide presence. Due to limitations imposed by time, certain restrictions in the investigational procedures were necessary. A signal species of fresh water algae was utilized in the complete investigation, although 2 other species were examined in the morphological studies. A single herbicide was used in all phases of the study. Finally, the physiological study was confined to the effect of herbicide presence on rate of respiration in algal cells.
W69-00994

SUB-SURFACE IRRIGATION OF TURF AREAS, NOZZLE DESIGN AND SPACING,
Massachusetts Univ., Amherst.
Lester F. Whitney.
Project Completion Report, Jan 1968. 11 p, 5 ref. OWRR Project A-015-Mass.

Descriptors: *Subsurface irrigation, *Distribution systems, Water pipes, Irrigation, *Nozzles, Orifices, Soil moisture, Moisture content, Orifice flow, Plastic pipes, Turf, Spatial distribution, Profiles, Water utilization.

Subsurface irrigation of crops and turf areas can permit up to a 40% reduction in water usage, provide automatic irrigation, and permit introduction of liquid chemicals into the root zone. The main deterrent to widespread adoption of this method has been the absence of an orifice which resists internal and external clogging; one which approaches the longvity of the polyethethylene plastic pipe lateral system. Results from this work have culminated with an injection-molded plastic insert nozzle which pierces the plastic pipe wall such that the inlet to a sized orifice is at the point of maximum velocity within the pipe. A labyrinthian protection for the orifice prevents external clogging. All in-wall orifices have been found to be unequivocally nonuniform and short lived. Spacing of orifices have been related to soil profiles and soil types for which flow parameters have been established. The findings are significant in providing a designed orifice for subsurface irrigation with maximum protection against internal and external clogging leading to a longevity approaching that of the base pipe material.
W69-00996

WATER POLLUTION CONTROL IN SEMI-ARID AND ARID ZONES,
Hebrew Univ., Jerusalem, Israel.
Hillel I. Shuval.
In affiliation with World Health Organization, Geneva. Water Research, Vol 1, No 4, pp 297-308, April 1967. 12 p.

Descriptors: *Water pollution control, *Arid lands, *Semiarid climates, Water conservation, *Water utilization, *Waste water disposal, Water quality, Water reuse, Domestic wastes, Groundwater recharge, Irrigation practices, Dry seasons, Public health, Sewage treatment, Sanitary engineering, Industrial wastes.

Limited water resources in semi-arid and arid zones caused special water pollution problems. Aspects of water utilization were discussed. It was suggested urban and industrial waste waters be utilized for direct irrigation, industrial purposes and recharging and replenishing the aquifer under arid zone conditions. Israel was presented as a case study in waste water utilization. Agricultural irrigation, both restricted and unlimited, were discussed as was water recharge. (Affleck-Ariz)
W69-01024

ALTERNATIVE METHODS OF IMPROVING STREAM QUALITY: AN ECONOMIC AND POLICY ANALYSIS,
Johns Hopkins Univ., Baltimore, Maryland
David F. Bramhall, and Edwin S. Mills.
Water Resources Research, Vol 2, No 3, pp 355-363, Third Quarter 1966. 4 fig, 2 tab, 9 ref.

Descriptors: *Water quality control, Economics, Waste disposal, Economic efficiency, Control, Low flow augmentation, Waste treatment, Costs, Governments, Water pollution, Taxes, Streamflow, Industries, Regulation.
Identifiers: *Public policy, Effluent fees.

Neither markets nor other institutional mechanisms exist which register the benefits and costs of alternative stream qualities or of alternative methods of achieving a given stream quality. It is therefore necessary to study such benefits and costs and to design special public policies to achieve desirable stream qualities in an economical way. The two most prominent methods of improving stream quality are waste treatment and low flow augmentation. Estimates are presented of the cost of achieving given stream qualities by various combinations of waste treatment and low flow augmentation. Data is taken from the author's study of future water supply and demand in Maryland, but the conclusions are thought to be applicable through the humid eastern part of the United States. The main conclusion is that low flow augmentation is a less economical method of improving stream quality than about 90% waste removal by secondary treatment, or its equivalent in industrial process changes at the point of waste generation. Alternative public policies for achieving improved stream qualities by economic methods are evaluated. A combination of effluent fees and enforcement is judged desirable. (Seneca-Rutgers)
W69-01068

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
Water Resources Engineers, Walnut Creek, California.

For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01071

OPTIMAL TAXING OF WATER POLLUTION,
Chicago Univ., Illinois.
Charles Upton.
Water Resources Research, Vol 4, No 5, pp 865-875, October 1968. 11 p, 3 fig, 11 ref.

Descriptors: Marginal costs, *Water pollution, *Water management, Water quality, Efficiencies, Biochemical oxygen demand, Dissolved oxygen.
Identifiers: *Optimal taxes, *Second order conditions, Subsidy, *Low flow augmentation, Nonpecuniary externality.

This paper attempts to show that within the context of the model presented, optimal taxes on water pollution do exist. The condition for these taxes is to raise revenue sufficient to pay for the cost of low flow augmentation. The social cost of cleaner water is also calculated. The 'waste' load discharge method of taxation is then shown to be preferable to the 'increased permissible waste load method' when taxes do not cover augmentation costs. The difference between augmentation costs and taxes, the subsidy, is defined as a function of marginal and average costs of streamflow. If there are economies of scale (MC<AC), then the subsidy is negative; if there are diseconomies of scale, it is positive. Taxes will cover treatment costs if and only if the subsidy is greater than or equal to zero. The rest of the paper is a study of the effects of three schemes that were proposed in a study undertaken for the Ohio Department of Health. The three questions asked about each scheme were: is it equivalent to the optimal tax; under what special conditions is it equivalent to the optimal tax; under what conditions is it the best nonoptimal tax. (Seneca-Rutgers)
W69-01084

RECOVERABLE WARP SIZES - A FEASIBILITY STUDY,
North Carolina Univ., Raleigh.
Harley Y. Jennings, and Richard N. Berrier.
Water Resour Res Inst Proj Completion Rep, Oct 1965. 5 p. OWRR Project A-006-NC.

Descriptors: *Textiles, *Water pollution control, *Industrial wastes, Liquid wastes, Water pollution sources.

The objective of this study was to examine in a very limited degree the possibility of recovering and reusing textile sizes. It was concluded that textile sizes constitute a pollution problem. There is little indication that the industry will attack the problem until required to do so, and the School of Textiles at N. C. State University should develop a program aimed at reducing stream pollution by textile sizes through substitution, recovery, and reuse of size materials. (Howells-NoCarolina)
W69-01110

PERSISTENCY OF 2,4-DICHLOROPHENOXYACETIC ACID AND ITS DERIVATIVES IN SURFACE WATERS WHEN USED TO CONTROL AQUATIC VEGETATION.
Southwestern Louisiana Univ, Lafayette.
William K. Averitt.
Louisiana Water Resour Res Inst, Sept 1967. 67 p, 33 fig, 7 ref, append. OWRR Project A-003-La.

Descriptors: *Herbicides, *2-4 D, Persistence, Aquatic plants, *Weed control, Alligatorweed, *Aquatic weeds, 2-4-5 T, *Hyacinth (Water), Pesticide residues.

The question of persistency and residues of various herbicides in surface waters, after being treated to control aquatic vegetation, is of prime importance in the maintenance of clean water. Laboratory and field test plots were sprayed with 2,4-D to control water hyacinth and alligatorweed. In some instances the PGBEE of 2,4-D or PGBEE of 2,4-5-Trichlorophenoxypropionic acid was also used. Residue determinations of the herbicides were about 800 ppb at 1 day after spraying and diminished to almost zero in 4 months time. In another series of tests, various organic acids were used in conjunction with the herbicides mentioned. Residue levels were similar to those in the tests when the herbicide alone was employed. However, it was noticed that the use of the organic acid increased the chemical activity, and the herbicide was found to have a somewhat delayed residue appearance in the water.
W69-01112

ACTIVITY OF MICROORGANISMS IN ACID MINE WATER.
Ohio State Univ, Columbus.
Jon H. Tuttle, C. I. Randles, and P. R. Dugan.
Jour of Bacteriology, pp 1495-1503, May 1968. 9 p, 6 fig, 1 tab, 12 ref. OWRR Project A-002-Ohio.

Descriptors: Acidic water, Water quality, Acidity, pH, Mine wastes, Aerobic bacteria, Ecology, Chemical analysis, Iron bacteria, Bacteria, Anaerobic bacteria, Water pollution, *Microorganisms, *Acid mine water, Water sampling, Streams.

Comparison of microbial content of acid-contaminated and nonacid-contaminated streams from the same geographical area indicated that nonacid streams contained relatively low numbers of acid-tolerant heterotrophic microorganisms. The acid-tolerant aerobes survived when acid entered the stream and actually increased in number to about 2000/ml until the pH approached 3.0. The organisms then represented the heterotrophic aerobic microflora of the streams comprised of a mixture of mine drainage and nonacid water. A stream which was entirely acid drainage did not have a similar microflora. Most gram-positive aerobic and anaerobic bacteria died out very rapidly in acidic water, and they comprised a very small percentage of the microbial population of the streams examined. Iron- and sulfur-oxidizing autotrophic bacteria were present wherever mine water entered a stream system. The sulfur-oxidizing bacteria predominated over iron oxidizers. Ecological data from the field were verified by laboratory experiments designed to simulate stream conditions.
W69-01115

WILLAMETTE RIVER BASIN WATER QUALITY CONTROL AND MANAGEMENT.
Federal Water Pollution Control Administration, Portland, Oreg.

Fed Water Pollut Contr Admin Rep, Jan 1967. 91 p, 18 fig, 53 photo, 11 map, 37 tab.

Descriptors: *Water quality, Water management, *Water pollution, *Pollution abatement, Waste treatment, Flow control, Oregon, Water utilization, Pulp wastes, Wood wastes, Pulp and paper industry, Saw mills, *Water quality control, Industrial wastes, Municipal wastes.
Identifiers: Willamette Riv Basin (Oreg.).

This report is the result of a in-depth study of the water quality of the Willamette River system, uses of the system, factors that affect water quality, probable nature of the economic development of the watershed and its impact on water quality, and the nature of measures to be taken both to abate pollution and prevent reoccurrence of pollution.
W69-01120

MANPOWER AND TRAINING NEEDS IN WATER POLLUTION CONTROL.
For primary bibliographic entry see Field 09A.
For abstract, see .
W69-01124

INVENTORY OF RESEARCH IN WATER POLLUTION AND RELATED FIELDS: COLUMBIA BASIN AND PACIFIC COAST STATES.
Federal Water Pollution Control Administration, Corvallis, Oreg.
For primary bibliographic entry see Field 09D.
For abstract, see .
W69-01125

THEORETICAL CONCEPT OF OXYGEN TRANSFER IN GAS BUBBLE AERATION SYSTEM.
Rhode Island Univ, Kingston.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01129

U-TUBE AERATION.
New Mexico State Univ, Las Cruces.
Richard E. Speece, and Jack L. Adams.
Tech Rep 38, Water Resour Res Inst, June 1967. 77 p, 26 fig, 3 tab, 8 ref, 2 append. OWRR Project A-011-NMex.

Descriptors: Water pollution, *Oxygen sag, Free surfaces, Diffusion, Air-water interfaces, *Dissolved oxygen, *Aeration, Dissolved solids, Solubility, Saturation, Oxygen, Low flow, Bubbles.

The diffused air U-tube aerator is especially adapted to capitalize on factors which increase oxygen transfer from air to water. It allows the contact time between the air bubble and water to be increased. The air-water interfacial area can be easily controlled. It allows the DO deficit to be increased. Finally, the diffused air U-tube aerator allows operation under a positive, zero, or negative head. Results of experimentation show that oxygen transfer in the U-tube is a function of air-water ratio, depth of U-tube, nominal water velocity, and air diffuser submergence. Results with pure oxygen injection showed about 5-fold increase in DO over air injection. A U-tube 40-ft deep, with a nominal water velocity of 8.4 ft/sec, and air injected at 1-ft submergence raised the DO from 0.2 to 4.0 mg/l. Difference in free water surface across the system was 5 in. Under the above conditions 13.8 lb of oxygen was transferred per hp-hr. Under conditions where 5 in. of head efficiency would be 85.4 lb of oxygen per hp-hr. Under standardized conditions, oxygen transfer rates in excess of 20 lb of oxygen per hp-hr were achieved.
W69-01132

TIME-INTEGRATED THERMAL EFFECTS OF FOREST IRRIGATION.
Pennsylvania State Univ, University Park.
Richard Lee, and William E. Sharpe.
Pap, 8th Nat Conf Gr Meterol, Ottawa, Canada, May 1968. 16 p, 5 fig, 5 tab, 24 ref. OWRR Project A-012-Pa.

Descriptors: *Forestry, Irrigation, *Temperature, Energy balance, Trees, Ecology, Sewage effluents, *Sewage treatment, Sensors, *Forests, Instrumentation, *Sprinkler irrigation, *Heat, Heat budget, *Waste treatment.

Changes of forest microclimates are reported as reflected in mean temperatures at various levels in treated stands. Irrigation treatments of 1 or 2 in. of treated municipal effluent were applied weekly, April through October 1967. The effluent was disinfected, clear, and odorless but not potable. Sprinklers were located 3 ft above ground level or above the canopies. Temperature sensors were placed in the upper 6 in. of mineral soil, 4-1/2 ft, and at 3 levels in the canopy, 28-, 33-, and 38-ft heights in Red Pine and 33-, 43-, and 53-ft heights in the hardwoods. A special temperature-sensing technique integration was used. Results of the investigation, with interpretation and significance are given.
W69-01141

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INSECTICIDE ADSORPTION BY LAKE SEDIMENTS AS A FACTOR CONTROLLING INSECTICIDE ACCUMULATION IN LAKES,
Wisconsin Univ, Madison, Wisconsin.
Erik G. Lotse, Gordon Chesters Graetz, and Gerhard B. Lee.
Rep, July 25, 1967. 42 p, 10 fig, 10 tab, 5 ref. OWRR Project B-008-WIS.

Descriptors: Adsorption, Pesticide kinetics, *Insecticides, Bottom sediments, Lake soils, Radiochemical analysis, Organic matter, Bonding, Clay minerals, Particle size.
Identifiers: Chlorinated hydrocarbons, Multiple regression, Lindane.

Lindane (gamma isomer of benzene hexochloride) adsorption was determined on eight intact lake sediments using a radiochemical technique. Lindane adsorption was shown to be affected by sediment suspension concentration, organic matter content, lindane concentration, clay content and lindane-sediment ratio and to obey Freundlich's equation. As the lindane molecule is neutral and not subject to ionization, van der Waals forces and hydrogen bonding were considered the most feasible adsorption mechanisms. The chlorine atoms of lindane are the most likely bonding sites to hydroxyl groups residing on the surfaces of the organic and mineral components of the sediments.
W69-01154

TRICKLING FILTERS AS A DAIRY-MANURE STABILIZATION COMPONENT,
Massachusetts Univ, Amherst.
D. O. Bridgham, and J. T. Clayton.
Manage Farm Animal Wastes, Amer Soc Agr Eng, St. Joseph, Mich, pp 66-68, 1966. 3 p, 6 fig, 3 tab, 9 ref. OWRR Project A-009-MASS.

Descriptors: *Trickling filters, Filters, *Waste treatment, Sewage effluents, *Farm wastes, Effluents, Settling Basins, *Cattle, *Dairy industry, Wastes, Biochemical oxygen demand, Pollution abatement.

Trickling filters are an effective means of reducing the polluting qualities of dairy manure and a possible means of treating effluent for discharge or recirculation. Loading rate and waste temperature have a great effect on the quality of the effluent. Nine points were plotted for this experiment and labeled according to average BOD of the effluent under respective conditions. Assuming a linear relationship between points, a topograph was drawn for various qualities of effluent. With bubbling aeration, a 1000-lb cow would require 334 cu ft of storage and treatment volume for 6 months of operation between sludge removals. An aeration tank, 134 cu ft in volume, was operated at 95 deg F. The estimated size for 70 deg F operation was 200 cu ft. Experiments support Webster's value for sizing primary sedimentation tanks of 200 cu ft per cow for biannual sludge removal. Test results show the volume of trickling filter required per cow to meet specific temperatures and effluent qualities. Experiments suggest a sedimentation tank volume of about 114 cu ft per cow instead of the 248 cu ft actually used. Therefore, a trickling filter system would require from 346 to 391 cu ft of tanks per cow to produce an effluent BOD of 200 ppm.
W69-01156

POLLUTION OF WATERWAYS IN THE ELLIOT LAKE AREA, ONTARIO,
Western Ontario Univ. London, Ontario, Canada.
Richard P. W. McCutcheon.
Ontario Geogr, No 2, pp 25-33, 1968. 9 p, 1 fig, 5 ref.

Descriptors: *Water pollution, *Mine wastes, *Radioactive wastes, *Municipal wastes, Aquatic algae, Uranium radioisotopes, Radium radioisotopes.
Identifiers: Elliot Lake, Ontario.

Rapid development of uranium mining in the Elliot Lake area, Ontario, caused widespread radiological and sewage pollution of the Serpent River system. The widely used acid leaching process of uranium ore treatment produces large amounts of waste, both solid and liquid. For each ton of ore, nearly 1 ton of tailings and at least 2 tons and as much as 5 tons of water, acids, and neutralizers are produced. Not all the uranium, and none of the Radium-226, is extracted from the ore, so the tailings piles contribute some radioactivity to water passing through them. Some lakes and streams contain more than the safe amount of radium. Leaks in the refining systems also contribute pollution. All sewage is treated, but lake and stream pollution by increased oxygen demand and increase of nutrients is common and has made one former swimming area obnoxious. No fish can live in Angel and Horne Lakes, and algae are present in excessive amounts. (Knapp-USGS)
W69-01165

A TEST OF FLUSHING PROCEDURES TO CONTROL SALT-WATER INTRUSION AT THE W P FRANKLIN DAM, NEAR FT MYERS, FLORIDA,
U S Geological Survey.
Durward H. Boggess
U S Geol Surv open-file rep, 20 p, 1968. 8 fig, 3 tab, 1 ref.

Descriptors: *Encroachment, *Saline water, *Gate control, *Locks, *Flow control, Navigation, Florida, Boating, Recreation.
Identifiers: Fort Myers (Florida), Lockage, Flushing.

A test was made of procedures to control salt water intrusion during lockage of boats at W P Franklin Dam near Ft Myers, Fla. Near the end of the dry season, in May 1967, the chloride content of river water about 3/4 mile upstream from the lock was about 500 mg/1. In early Mar 1968, the chloride content was about 250 mg/1. Proposed tests included flushing the lock chamber by partial opening of the downstream gate and full opening of the upstream gates prior to lockages, scheduling lockages instead of performing them on demand, and flushing during lockages. A test of flushing before lockages was performed. Salt water was flushed from the lock chamber with gate openings of 4,6, and 8 ft. An opening of 8 ft or more appears preferable because of the smaller volume of water required and less discharge time involved. It is questionable whether sufficient quantities of water will be available for flushing. For example, assuming that the volume of water needed is about 340 acre ft per day (170 cfs), then more than 10,000 acre ft would be required for a 30 day period. For 68 consecutive days between Mar and June 1967, no water other than lockage and leakage was discharged, and for 77 consecutive days discharge was less than 170 cfs. This long period of low flow may represent near extreme conditions, but the availability of water required for flushing should be assured if these procedures are to be adopted. (Knapp-USGS)
W69-01168

CHEMICAL QUALITY OF WATERS OF BROWARD COUNTY, FLORIDA,
U S Geol Surv.
Rodney G. Grantham, and C. B. Sherwood.
Florida Div of Geol Rep of Invest No 51, 52 p, 1968. 16 fig, 3 tab, 18 ref.

Descriptors: *Chemical properties, *Florida, *Aquifer characteristics, Surface-groundwater relationships, Water pollution, Water quality.
Identifiers: *Broward County, Herbicide pollution, Canal water.

Results of a water resources study which emphasizes the chemical quality of waters in Broward County, Florida, are presented. The water is calcium bicarbonate and ranges from hard to very hard, and from neutral to slightly alkaline. Most of the water used in the County is obtained from the Biscayne aquifer, recharged by local rainfall and by water that infiltrates from the canals. The chemical quality in the interrelated surface and groundwater system is generally good. The Floridan aquifer yields brackish water by artesian flow; sewage is disposed in the aquifer at one location. Chemical weed killers applied on the land, as well as detergents, have been detected in the groundwater, indicating movement of waste through the ground. The chemical quality of surface water varies seasonally. The mineral content of canal water does not exceed 550 ppm. Continued monitoring of saltwater intrusion and waste disposal effects is necessary to help prevent future contamination. (Llaverias-USGS)
W69-01171

06. WATER RESOURCES PLANNING

6A. Techniques OF Planning

MANAGEMENT OF HYDROLOGIC SYSTEMS FOR WATER QUALITY CONTROL,
California Univ., Berkeley.
Philip C. Woods.
Water Resource Center, San Eng Res Lab, Contrib 121, June 1967. 121 p, 39 fig, 4 tab, 56 ref, append. OWRR Project A-004-Cal.

Descriptors: *Water quality, *Water management, Hydrology, Irrigation, *Irrigation practices, Simulation, Irrigation O and M, Groundwater flow, Computer programming, Ground water, Salinity, Salts, Mathematical analysis, Control, Water pollution, Bibliographies, California, *Water quality control, Mathematical models.
Identifiers: *Hydrologic models, Sacramento River, Calif.

By a series of mathematical models and digital computer techniques an approach was made to predicting the water quality response of hydrologic systems to changes in irrigation practice. The results obtained by simulating the Sacramento River System were compared to the quality response of the prototype. The potentialities of simulation in systems management were illustrated using the 'X' Hydrologic System. Its sensitivity to incorrect selection of parameter values was examined, as were the system changes that could be induced by altering parameters which are subject to management decisions. From the results it can be expected that a simulation approach will lead to the development of dependable optimizing techniques, the ultimate goal of water quality management. (McGauhey-Calif)
W69-00724

MANAGEMENT MODELS FOR WATER RESOURCE SYSTEMS,
Cornell Univ., Ithaca, N. Y.
Daniel P. Loucks.
Water Resour Center, Tech Rep 1, June 1967. 130 p, 12 fig, 8 tab, 246 ref, 7 append. OWRR Project A-002-NY.

Descriptors: *Systems analysis, *Water management (Applied), Reservoir operation, Water quality, Flow control, Linear programming, Decision making, *Water resources, Policy matters, Mathematical models.

Analytical methods are presented to assist in the establishment of policies for managing developed river systems. Both deterministic and stochastic linear programming models are structured for determining reservoir releases and allocations of water to each flow and stock use that meet some management objective. Three possible objectives are discussed and incorporated into the models, namely maximization of total expected net losses, and minimization of total expected deviation from

each use or expected allocation. This latter is suggested if no economic benefit-loss data are available. Two deterministic linear programming models for water quality management are discussed. These models indicate the minimum cost required to maintain particular dissolved oxygen standards within the system and increase in costs resulting from any social, legal or administrative constraints. Extensions of these models and some economic implications are presented in the appendix.
W69-00737

MANAGEMENT OF HYDROLOGIC SYSTEMS FOR WATER QUALITY CONTROL,
California University, Berkeley, Water Resources Center.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-00938

PROBLEM OF ALTERNATIVES IN WATER RESOURCE MANAGEMENT,
Resources for the Future, Washington, D. C.
Robert K. Davis.
The Range of Choice in Water Management, 1968, Chap 1, p 3-10, 2 ref.

Descriptors: Water resource management, Federal project planning, Evaluation, Project planning, Institutional constraints, *Political aspects, Administrative decisions, Assessments, Intangible benefits, Social values, *Optimum development plans, Jurisdiction.
Identifiers: Operating responsibility, *Assessment of alternatives, Technology.

Several important questions should be asked in considering the probable implementation of alternatives: (1) How broad an array of alternatives are technologically possible; (2) What analytic problems do they present; (3) What institutional or procedural forms might be obstacles to certain alternatives; (4) How can planners be encouraged to explore the range of choice. The comparison of alternatives, including their measurable costs and returns, as well as their difficult-to-measure consequences, provides the best basis we have for intelligent consideration of important intangible values. However, this practice of comparison has not been put into effect. One reason is the technical difficulty of presenting all the alternatives. Five factors contribute to this problem: (1) various combinations of variables make the number of alternatives to be considered enormous, (2) deficient physical and biological knowledge, (3) inability to competently assess economic and social factors, (4) changing technology, (5) difficulty of assessing intangible benefits and costs. These factors make it difficult to define an optimum solution in an objective manner. Several features of the institutional environment also inhibit and complicate the task of exploring and evaluating alternatives. These are (1) limited jurisdiction of water agencies, (2) political bias in favor of certain alternatives, and (3) an agency's adaptability is limited by past perceptions and solution of problems. (Gargola-Chicago)
W69-00950

THE OPTIMIZATION OF LARGE SCALE WATER RESOURCE SYSTEMS: OPERATIONAL ASPECTS, PART 1: CONCEPTUAL FRAMEWORK,
California Univ., Los Angeles.
Nathan Buras.
University of California, Sept 1965, 34 p, 8 fig, 8 ref.

Descriptors: Computer programs, Reservoirs, Data processing, *Dynamic programming, Linear programming, Water utilization, Optimum development plans, Hydrological data, *Mathematical models, Hydroelectric power, Water supply, Dimensional analysis.
Identifiers: Trinity Reservoir, Folsom Reservoir, Oroville Reservoir, Shasta Reservoir, Optimal operating procedure, California.

A water resource system consisting of four reservoirs was analyzed with respect to its operation in an integrated manner. The reservoirs release water for irrigation and municipal and industrial use, and for the generation of hydro-electric power. It is required to (1) determine the maximum amount of firm water and firm power which may be produced by the system, and (2) determine an optimal operating procedure for the satisfaction of the target outputs determined by (1) above. Only part (1) was discussed. The optimization of the entire system using dynamic programming was found to be unfeasible due to the large dimensionality of the problem: at least one dimension for each reservoir of subsystem. Consequently, the decomposition principle was applied using a combination of dynamic programming (for the optimization of each subsystem) and linear programming (for the optimization of the master program). Hydrological data covering ten consecutive years and including lowest inflows on record were supplied so that ten different values of firm water and firm power may be calculated. On the basis of these results, the target outputs for the system as a whole, in terms of firm water and firm power, may be determined. (Gargola-Chicago)
W69-00961

MATHEMATICAL ASSESSMENT OF SYNTHETIC HYDROLOGY,
U. S. Geological Survey, Washington, D. C.
N. C. Matalas.
Water Resources Res, Vol 3, No 4, pp 937-945, 1967. 9 p, 12 ref.

Descriptors: *Synthetic hydrology, Markov processes, Mathematical models, Stochastic processes, Statistical methods.

To generate multivariate synthetic sequences that will resemble multivariate historic sequences in terms of means, standard deviations, skewnesses, lag-one serial correlation, and lag-zero cross-correlations, a multivariate, weakly stationary process is used. Techniques of regionalization and maximum likelihood estimates may be used to minimize the biases associated with the estimates of the parameters that characterize the historic sequences. (Author)
W69-01056

SYNTHETIC HYDROLOGY BASED ON REGIONAL STATISTICAL PARAMETERS,
U. S. Geological Survey, Washington, D. C.
M. A. Benson, and N. C. Matalas.
Water Resources Res, Vol 3, No 4, pp 931-935, 1967. 5 p, 3 tab, 8 ref.

Descriptors: *Synthetic hydrology, *Regression analysis, Stochastic processes, Mathematical models, Sampling, Statistical methods.

The subject of synthetic hydrology, the generation of a long series of hydrologic events by use of the statistical parameters based on a short sample, is reviewed. A method is proposed to correct deficiences caused by large original sampling errors and the lack of a way to generate series for ungaged locations. All the longer streamflow records in a region are used and the relations between the variables are determined by standard multiple regression methods. The relations are based essentially on a random sampling of the variables, so they are applicable to all basins, gaged or ungaged, in a studied region' their use reduces short-sample error. Relations defining statistical parameters for the Potomac basin are presented as an example of the method. (Knapp-USGS)
W69-01057

BROAD HORIZONS IN WATER RESOURCE PLANNING AND INVESTMENT,
Resources for the Future, Washington, D. C.
Charles W. Howe.
Water Resources Research, Vol 2, No 4, pp 843-847, Fourth Quarter 1966. 1 tab, 7 ref.

Descriptors: *Planning, Water resources, Investment, Governments, Benefit-cost ratio, Costs, Harbors.
Identifiers: Public policy, Private enterprise.

In spite of the vastly expanded knowledge and computational abilities available in the planning of water resource systems, the scope of most planning efforts remains too narrow. It is argued that planning efforts must be broadened in three ways: (1) geographically, to take into account not only hydrological interdependencies but the wider range of market and financial relationships; (2) between public and private sectors to assure that public investments yield sufficiently high returns; (3) to encompass all relevant alternatives, both technological and institutional, for attaining the objectives of development. Examples of the costs resulting from the failure to use sufficiently broad horizons in planning are provided for several water resource problems. (Seneca-Rutgers)
W69-01069

CAN WE SOLVE OUR WATER PROBLEMS,
Resources for the Future, Washington, D. C.
Irving K. Fox.
Water Resources Research, Vol 2, No 4, pp 617-623, Fourth Quarter 1966. 7 ref.

Descriptors: Costs, Return, *Administration, Irrigation, *Water resources, *Legislation, *Water supply, Water quality, Water Resources Planning Act, Governments.
Identifiers: Public policy, Private enterprise.

Water problems may be thought of as occurring in three major areas. One problem area is the urgent need of maintaining a continuously advancing science and technology, especially in water quality management. Another problem area is that of balancing costs and returns from water development and use. It has proven to be uncommonly difficult to achieve a consensus on costs and returns, which, in turn, has often made it difficult to proceed with water programs. A third problem area stems from the inadequacy of water management institutions. Laws, policies, and organizational arrangements have not kept abreast of the requirements of a rising demand and an advanced technology. In recent years we have greatly improved our ability to deal with these problems. Recent action by both government and private organizations reflect a determination to solve the problems which remain. Three key issues now merit priority attention: (1) finding better ways of providing officials and the public with authoritative information; (2) establishing institutions capable of operating complex water management programs; (3) modifying public policy to improve the performance of private enterprise. (Seneca-Rutgers)
W69-01070

STORAGE REQUIREMENTS FOR WATER IN THE UNITED STATES,
Resources for the Future, Washington, D. C. and U. S. Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-01073

ON RESERVOIR SITE PRESERVATION POLICY,
Resources for the Future, Washington, D C.
Allen V. Kneese.
Water Resources Research, Vol 2, No 3, pp 607-614, Third Quarter 1966 3 ref.

Descriptors: *Reservoir sites, *Pre-impoundment, Costs, *Value, Market value, Property values, Economic efficiency, Legislation, Governments, *Regulation, Taxes, *Zoning, Planning.
Identifiers: *Reservoir site preservation policy, Opportunity costs, Equity, Government acquisition, Development rights.

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It is not obvious that reservoir site preservation policies should be adopted. Before such a policy is implemented, consideration should be given to the value of the sites for alternative uses. In some cases the free market registers these opportunity costs accurately. However, under certain circumstances the free market prices do not reflect these costs. For example, the market price of land may be bid up in anticipation of its purchase as a reservoir site. Public action to preserve reservoir sites could depend upon one of three governmental powers: the power to regulate the use of property, the power to acquire property and the power to tax. There are many methods of site preservation. These methods can be evaluated in terms of the following criteria: (1) economic efficiency, (2) equity, (3) public outlay required, (4) changes in the law required. Various methods such as zoning, acquisition and compensable regulations are analyzed on the basis of these criteria. The analysis suggests the compensable regulations may be the most basic device for the preservation of reservoir sites, although other devices might be more effective in particular situations. (Seneca-Rutgers)
W69-01080

WATER PRICING: A SOCIAL DECISION-MAKING PROCESS,
California Univ., Los Angeles.
For primary bibliographic entry see Field 06C.
For abstract, see .
W69-01082

AN OPTIMIZATION METHOD FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
Texas A and M Univ., College Station and Texas Univ., Austin.
W. L. Meier, Jr., and C. S. Beightler.
Water Resources Research, Vol 3, No 3, pp 645-652, Third Quarter 1967. 6 fig, 11 ref.

Descriptors: *Optimization, *Dynamic programming, Planning, River systems, River basins, Reservoir, Water resources development.
Identifiers: *Nonserial systems, *Serial systems, *Multi-stage process, State, Decision, Stage, Return, Transition, Cut state.

Several optimization procedures have been proposed for the analysis of complex water resource planning problems. One of these techniques, dynamic programming, has been limited in its applicability to river basin systems because these systems are nonserial and dynamic programming is by nature a serial procedure. Recently developed methods are discussed and illustrated with example problems for decomposing the nonserial river basin system into equivalent serial systems amenable to analysis by the dynamic programming method. (Seneca-Rutgers)
W69-01092

TOWARD COMPREHENSIVE WATER RESOURCES MANAGEMENT IN THE CALUMET UNION DRAINAGE SYSTEM.
Northeastern Illinois Planning Commission, Chicago, Ill.

Report Northeastern Illinois Planning Commission, Chicago, Ill, 1966, 16 p, 3 fig, 1 tab, 6 ref.

Descriptors: Local governments, Water resources management, *Interagency cooperation, *Project planning, Project purposes, Formulation, Urbanization, Social needs, State governments, *Flood control, Multipurpose projects, Community development, Low flow augmentation.
Identifiers: Calumet Union Drainage System.

In the Calumet Union Drainage System, flooding is a significant problem. It is of short duration and occurs at infrequent intervals. This general situation is reviewed in terms of the blight it has created. This area cannot afford the luxury of a single-purpose flood control project where inadequate flow, urban ugliness, and slum housing exist and are associated with the flood problem. Suggested improvements by the Army Corps of Engineers, U. S. Geological Survey, various State agencies, the Metropolitan Sanitary District of Greater Chicago, and the Illinois Division of Waterways are given. The Northeastern Illinois Planning Commission outlines its own plan. Easy accessibility to surrounding municipalities demand that the potential recreational value of the site be utilized. A recreational lake with adjacent field for storage of flood waters is proposed. Housing or a community college could be built by the lake. Organization for this plan could be handled through the Urban Renewal Board. Steps following that are defined and agencies that would be involved in any development of the area are outlined. (Gargola-Chicago)
W69-01093

NORTHEASTERN ILLINOIS WATER RESOURCE ORGANIZATION INQUIRY.
Illinois Department of Business and Economic Development, Springfield, Illinois.

Report, Northeastern Illinois Planning Commission, Chicago, Feb 1968. 11 pp.

Descriptors: Decision making, Adoption of practices, Water resource development, Administrative procedure, Community development, State governments, Administrative agencies, Project planning, *Interagency cooperation, *Regional planning, *Future planning, Short term planning, Long term planning, Management, Institutional constraints.
Identifiers: Northeastern Illinois.

To consider possible methods of organizing for coordinated water resources planning and development in Northeastern Illinois four groups were called together. Consultants, suburban managers, technical advisors, and a planning commission subcommittee, reviewed (1) organizational needs, functions and programs, (2) structural form, and (3) enforcement factors. There was general agreement on the need to begin with coordination and mutual adjustment of existing programs. Short and long range planning must be provided in order to meet immediate critical requirements and prepare for future development. A form of regional management was generally approved to be the best system for water resource management planning as well as operational coordination. The Planning Commission should continue to play a major role in water resource planning and the coordination of this with other aspects of comprehensive planning for the region. Subcommittee findings and recommendations are summarized with suggestions for meeting critical immediate requirements. (Gargola-Chicago)
W69-01094

PRODUCTION TECHNOLOGY IMPERFECT COMPETITION, AND THE THEORY OF LOCATION: A THEORETICAL APPROACH,
Wisconsin Univ., Madison.
Gilbert A. Churchill, Jr.
Southern Economic Journal, Vol 34, No 1, pp 86-100, July 1967. 2 fig.

Descriptors: *Industrial plants, *Sites, Costs, Initial costs, Competition, Demand.
Identifiers: *Facility location analysis, *Location theory, *Production technology, *Imperfect competition, Plant size.

Facility location analysis is used to determine the best location for a single firm. The author attempts to extend the theory of facility location in several ways: (1) by introducing more realistic transport costs; (2) by including imperfectly competitive factor markets within a location model; (3) by explicitly incorporating plant size within a spatial model; (4) by treating production technology directly, thereby allowing factor substitutions with output changes at each site; and (5) by introducing monopolistic competition in the product market which is attributable to product differences rather than to competitor locations. The extensions are demonstrated with a theoretical 'point' location model. The model is developed from the vantage point of a single firm faced with the location decision. Hypothetical functions are used to develop the model. It is assumed that the firm attempt to maximize profits and this single consideration guides the determination of the level at which output should be planned as well as where the product should be produced. Within his spatial model, the author attempts to integrate stock-flow production theory, transportation economics and existing location theory. (Seneca-Rutgers)
W69-01098

INDIVIDUAL PREFERENCE INTRANSITIVITY,
Southampton Coll., Long Island, N. Y.
Arnold A. Weinstein.
The Southern Economic Journal, Vol 34, No 3, pp 335-343, January 1968. 2 fig.

Descriptors: Psychological aspects, Decision making.
Identifiers: Choice, *Preference patterns, *Intransitivity, Indifference curve analysis, Bands of indecision, Rationality.

The causes of observed individual intransitivity are divided into five categories: (1) true irrationality of a clinical nature as; (a) the situation where the thought of one alternative affects the desirability of another alternative; (b) conflict between the superego and the id or ego; (c) the desocialized or unsocialized individual; and (d) role conflict; (2) observed intransitivity caused by; (a) the lack of communications between the experimenter and subject; (b) the subject's changing tastes; (c) boredom with the experiment; (d) playing a game with the experiment; or (e) the experimenter asking the wrong question; (3) observed intransitivity caused by non-allowance for indifference; (4) true intransitivity caused by man's imperfect sensitivity to his environment or himself and (5) rational intransitivity due to the high cost of holding a preference ordering. If verified, the last cause leads to a modification of indifference curve analysis which would significantly affect the derivation of Pareto optimality by market conditions. A conceptual tool entitled 'Bands of Indecision' is developed to demonstrate this condition. (Seneca-Rutgers)
W69-01100

SOME BOUNDS UPON THE PARETO OPTIMALITY OF GROUP BEHAVIOR,
Australian National Univ., and Princeton Univ., New Jersey.
Clem Tisdell.
Kyklos, Vol XIX, No 1, pp 81-104, First Quarter 1966.

Descriptors: *Welfare, *Model studies.
Identifiers: Conflict of interest, *Pareto optimality, *Group behavior, Maximization, *Interdependence, *Game theory, Uncertainty.

This article puts special emphasis upon those obstacles to the Pareto optimality of group behavior which arise from the imperfection of man's knowledge. Bounds upon Pareto optimal behavior are discussed for three limiting societies: (1) a society in which all members are independent, (2) one in which only one-way dependencies can arise, and (3) one in which all members are completely interdependent. Insights drawn from these cases can be used in discussing non-limiting ones. Account is then taken of the fact that few groups exist in isolation and some formal conditions, which may often make it impossible for a group to achieve a Pareto optimality, are stated. It is shown that Pareto optimality of group behavior is limited by factors such as individual's imperfect knowledge of their own preferences, barriers to discovering the preferences of others, limitations imposed by the good faith of parties to agreement, the intrusion of emotional factors, e.g., in bargaining false notions

by individuals of their own predictive powers, and by other uncertainties about possible acts and the relationship between acts and outcomes. (Seneca-Rutgers)
W69-01102

A NOTE ON CONSUMER BEHAVIOR IN AN URBAN HIERARCHY,
Canterbury Univ, New Zealand and National Univ, Australia.
R. J. Johnston, and Peter J. Rimmer.
Journ of Regional Science, Vol 7, No 2, pp 161-166, Winter 1967. 2 fig, 2 tab, 3 ref.

Descriptors: *Demand, *Behavior, *Cities.
Identifiers: *Consumer behavior, Central place theory, Rationality, Australia.

The structural concepts of central place theory, including the idea of hierarchy, are based on a number of assumptions concerning consumer behavior. All of the assumptions imply rational human actions and complete knowledge. This article makes an investigation into the validity of these assumptions, using a series of small towns in Victoria, Australia as its study area. A sample of residents were questioned on their normal shopping habits. The tabulated results indicate that this behavior does not generally accord with the assumptions of central place theory. Part of the explanation of this lies in the extreme primacy of Melbourne within Victoria so further research is necessary within other urban systems. (Seneca-Rutgers)
W69-01109

APPLICATION OF ELECTRONIC ANALOG COMPUTER TO SOLUTION OF HYDROLOGIC AND RIVER-BASIN-PLANNING PROBLEMS: UTAH SIMULATION MODEL II,
Utah State Univ, Logan.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01145

THE VALUE OF A TROUT STREAM FISHERY,
Utah State Univ, Logan.
Archie A. Dyer.
Final Rep Utah Water Resour Res, Dec 1967. 49 p, 5 fig, 12 tab, 18 ref, append. OWRR Project B-008-UTAH.

Descriptors: *Recreation, Competing uses, Value, Cost benefit analysis, Social values, Economic prediction, Regression analysis, Utah, Income, Age, *Trout, Sport fish, *Fisheries, Fishing.

The data analysis indicated that travel distance, user age, and user income level are important determinants of use of trout streams. These variables were incorporated into regression analysis to develop a use-prediction model. This model was used to determine predicted use levels of sample streams. The predicted use levels combined with travel costs and expenditures on new fishing equipment were used to derive a statistical estimate of the demand schedules for the sample streams. These statistical demand curves were subjected to consumer surplus procedures to determine the values of the sample streams.
W69-01147

6B. Evaluation Process

NEW HORIZONS IN WATER RESOURCES ADMINISTRATION,
Resources for the Future.
Irving K. Fox.
Public Administration Review, Vol. 25, No. 1, 1965, p 61-69, 29 ref.

Descriptors: Resource development, Interest rate, Indirect benefits, Intangible benefits, Systems analysis, *Interagency cooperation, *Decision-making, Water resource development, Project planning, Political aspects, Administrative decisions, Administrative agencies, *Economic evaluation, Optimum development plans, Regional analysis, *Welfare economics.
Identifiers: Projection of demand, Market process.

The significant developments in water resource activities are reviewed for the past fifteen years. The search for efficiency is explored, with emphasis on the applicability of welfare economic theory. The major problems in evaluating water resource investments--secondary benefits, range of alternatives, projections of demand, and consideration of variables--are discussed. Three measures: (1) adoption of policies which rely on market-like processes; (2) restructuring policy patterns, agency authority and responsibility; and, (3) making greater use of countervailing influences are suggested for achieving greater efficiency in development. It is concluded that research in policy-institutional structure is far behind technical aspects of water resource development, and must be improved to better implement future planning. (Gargola-Chicago)
W69-00705

LOCAL ACTION AND ACCEPTANCE OF WATERSHED DEVELOPMENT,
Mississippi State Univ., State College.
For primary bibliographic entry see Field 04D.
For abstract, see .
W69-00716

THE PRESENT AND FUTURE GROUND WATER SUPPLY OF THE BATON ROUGE AREA,
Louisiana State Univ., Baton Rouge.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00720

WATER FOR TEXAS.
Texas A and M Univ., College Station.

Proc 11th Annu Conf, Water for Texas, Nov 21-22, 1966. 66 p, 10 fig, 3 tab, 57 ref.

Descriptors: *Water resources, *Water resources development, Weather modification, Planning, Evaporation control, Estuaries, Recreation, Water management (Applied), Fish establishment, Water quality, Water reuse, *Water utilization, Water development, Water law, Pollution abatement, Texas, Bibliographies.
Identifiers: *Water use, Water plans.

The Proceedings of the 11th Annual Water for Texas Conference held at Texas A and M University, College Station, Tex, Nov 21-22, 1966, include 13 papers developing the theme Challenges of the Present. Developing Total Resource, Estuarine Problems, and Recreational Impact are subthemes representing water resource problem areas which need immediate attention if Texas is to meet the challenge of effective utilization of water resources. Concepts set forth by recognized authorities on water resource planning will be of value to water planners and researchers as Texas water problems are considered in the immediate future.
W69-00725

SOCIOLOGICAL FACTORS IN WATERSHED DEVELOPMENT,
Mississippi State Univ., State College.
Kenneth P. Wilkinson, and Lucy W. Cole.
Water Resources Res Inst Rep, Jul 1967. 48 p, 127 ref. OWRR Project A015-Miss.

Descriptors: *Project planning, Water resources development, *Community development, Economics, *Social aspects, Social impact, Watersheds, Social participation, Sociology, Social sciences, Small watersheds, Watershed management.
Identifiers: Water resources management, Social acceptance.

The technical process of watershed project action is often hindered by social problems. Increasing awareness by program administrators has resulted in a search for scientific approaches to citizen involvement in watershed planning. Sociological resources relevant to water-related problems have rarely been applied in other than superficial ways. A strategy is proposed by which sociological research can be more effectively oriented to problems experienced by water management professionals. A sociological field theory is outlined as foundation for the needed program of research. A review of social science literature concerning watershed action reveals a variety of findings and hypotheses for research, but little sustained integration of theory with findings. Analysis of data on watershed needs and projects in Mississippi as related to demographic and social-organizational characteristics of communities yields findings which are suggestive of a relationship. The general conclusion reached is that rigorous efforts in theoretical and operational development will be necessary to assess the influence of community forces in watershed development.
W69-00732

AN ACT CREATING THE WATER RESOURCES BOARD, DEFINING ITS POWERS AND DUTIES.

Illinois Laws 1967, Act 1191.

Descriptors: *Illinois, United States, Legislation, *Water Resources Development, Universities, Financing, Water utilization, Land resources, Projects, Navigation, Flood control, Rivers, Bodies of water, Watersheds (Basins), Local government.
Identifiers: Water Resources Board, Resources Development Act.

The composition and financing for the Water Resources Board is described. The Board's functions are: to inform citizens of the condition of water and related land resources; to advise the Governor on legislation; to coordinate activities of state agencies; to examine the effects of state programs; to review proposed projects to determine priorities; to act for the state on projects for the improvement of navigation, flood control or for purposes of the United States involving rivers, waters or watersheds; to administer financial assistance to local governments for water resources planning; to establish and supervise regional water resources management commissions; to receive funds; and to administer the Resources Development Act. (Childs-Fla)
W69-00755

DESIRABLE FEATURES OF WATER RIGHTS LAWS,
Nebraska Dept of Water Resources, Lincoln, Nebr.
Dan S. Jones.
J of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 89, No IR4, part 1, pp 1-6, Dec 1963.

Descriptors: Irrigation, *Water rights, Water distribution (Applied), Water law, Preferences (Water rights), Appropriation, Prior appropriation, Surface waters, Stream gages, Groundwater, *Nebraska, Riparian rights, Competing uses, *Legal aspects, Federal-state water rights conflicts, Water allocation (Policy).

The coexistence of the riparian and appropriation doctrines creates uncertainty and makes orderly administration of the law difficult. The law should declare that all waters of the state are public and are subject to appropriation and use as provided by law. All uses of water, except for ordinary household purposes, should be subject to control by one central state administrative agency having authority to police the streams, to grant water rights, and to cancel such rights when the appropriator ceases to use the water for the purpose for which the appropriation was granted. The decisions of the administrative agency should be appealable directly to the Supreme Court. The law

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should indicate certain preferential uses of water and the use of water for such a purpose should be permitted provided that a prior appropriator for an inferior purpose is adequately compensated for any interference resulting therefrom. The water rights law should apply equally to all who desire to use the public waters, including agencies of the United States. (R. Smith-Fla)
W69-00760

AN ACT CONCERNING LONG RANGE WATER RESOURCES PLANNING.
Connecticut Public Act No 477 (1967).

Descriptors: *Planning, *Connecticut, Long-term planning, Project planning, Administrative agencies, Budgeting, Coordination, Legislation, Water resources development, Water allocation (Policy), Water utilizations, State governments, Local governments, Water policy, Administration, Water supply, Water resources.

The act provides for the formulation of a long-range statewide plan for the management of the water resources of the state. The Water Resources Commission, the State Department of Health, the State Board of Fisheries and Game, and the Connecticut Development Commission are responsible for preparing the plan. They are to design a unified planning program, coordinate regional water and sewer plans and assist local planning. The act sets up objectives and guidelines for the plan and provides for its submission to the general assembly. (Horner-Fla)
W69-00767

DELAWARE RIVER BASIN COMMISSION.
18 CFR Ch 3, Sec 401.0-401.52 (1968).

Descriptors: *Delaware, *Delaware River Basin Commission, Conservation, Legislation, *Water resources, River basin development, Impoundments, Ground water, Sewage treatment, Surface water, Dredging, Bridges, Projects, Administrative agencies.
Identifiers: *Comprehensive Plan, *Water Resources Program, Delaware River Basin Compact.

The basic purposes and general methods of operation of the Delaware River Basin Commission are described. Subpart A governs the submission, consideration, and inclusion of all projects, public and private, into the Comprehensive Plan. This Plan includes all projects which the Commission decides are required for the development, planning, conservation, use, management and control of the water resources of the Delaware Basin. Subpart B governs the submission, consideration, and inclusion of these projects into the Water Resources Program which is the annual presentation of the quantity and quality of water resource needs of the area to be served during the next six years or shorter period balanced by existing and proposed projects required to satisfy such needs and a statement of the projects to be undertaken during this period. Subpart C governs the submission and review of projects under Section 3.8 of the Delaware River Basin Compact. Certain projects are designated as having no substantial effect on the water resources of the Basin and are thus not required to be submitted for review. Subpart D defines terms used in this act. (Childs-Fla)
W69-00774

WATER RESOURCES COUNCIL.

18 CFR Ch 6, part 701 and 703 (1968).

Descriptors: *United States, Legislation, *Water Resources Planning Act, *Conservation, Water resources, *River basins, Projects, Navigation, Federal Power Act, Land resources, Grants, States, Irrigation, River Basin Commission.
Identifiers: *Water Resources Council, Secretary of Agriculture.

The Water Resources Council is to carry out the purposes in the Water Resources Planning Act. These purposes are conservation, development, and utilization of water and related land resources. The Council's functions are: (1) to assess the adequacy of water supplies; (2) to study the relation of regional and river basin plans to the requirements of larger regions; (3) to appraise the adequacy of present means of implementing water and related land resources policies; (4) to establish standards for regional or river basin plans; and, (5) to coordinate federal agencies in river basin planning. The Act describes the composition and operating procedures of the Council and provides the methods of administration of grants to states to encourage: (1) state participation in federal-state comprehensive water and related land resources planning; (2) state preparation of plans for use of these resources; (3) state training of personnel to develop planning capability. The Act also provides for compliance with the Civil Rights Act. (Childs-Fla)
W69-00777

AN ACT REORGANIZING AND RENAMING THE RHODE ISLAND WATER RESOURCES COORDINATING BOARD, AND EXTENDING ITS POWERS AND DUTIES.

Rhode Island Laws 1967, Ch 156. 18 p.

Descriptors: *Rhode Island, Legislation, *Administrative agencies, Administration, *Water resources development, Water supply, Regulation, Projects, Reservoirs, Water sources, Cities, *Water permits.

Chapter 46-15 of the general laws is amended in its entirety. A nine-member water resources board is created. The board is empowered to: (1) acquire property and interests therein for reservoirs and facilities to treat and distribute waters contained in such reservoirs; (2) construct reservoirs and facilities; (3) formulate and maintain a long-range guide plan for development of water sources; (4) to provide for cooperation in such development; and (5) to make loans to publicly owned water supply agencies. Board approval is required for any additon to or extension of the facilities of municipal water agencies, or diversion of water to another state. Upon an application to the board for a new or additional water supply or source thereof, the board may require of authorize the applicant to make provision for the supply of, and to supply water to, any other area of the state. Board personnel is provided for an authorized to enter any lands to make surveys, and examine books and records. The board is to take the place of the old water resources coordinating board. Board-owned and authorized property is exempted from taxation. The board is authorized to make general rules and regulations. (R. F. Williams-Fla)
W69-00780

ESTUARIES - INVENTORY - STUDY, SENATE REPORT NO 1419.
U S Code Cong and Admin News, Vol 1968, No 10, pp 3658-3679, Sept 20, 1968. 22 p.

Descriptors: *Legislation, *Federal government, Bays, Administrative agencies, *Estuaries, Rivers, Aquatic habitats, Currents (Water), Grants, *Estuarine environment, Gulfs, Inlets (Waterways), Intertidal areas, Saline water fish, Sea water, Wildlife conservation.

The Senate Committee on Commerce reported favorably on a proposed bill to authorize the Secretary of Interior, in cooperation with the states, to conduct an inventory and study of the Nation's estuaries and their natural resources. An estuary is a semienclosed coastal body of water having a free connection with the open sea and within which the sea water is measurably diluted with fresh water derived from land drainage. The purpose of this bill is to provide a means for considering the need to protect, conserve, and restore these estuaries in a manner that adequately and reasonably maintains a balance between the national need for such protection in the interest of conserving the natural resources and natural beauty and the need to develop these estuaries to further the growth and development of the Nation. The result of this study would be due Jan 30, 1970, at a cost of $500,000. (R. H. Watson-Fla)
W69-00781

THE ECONOMIC DYNAMICS OF RIVER BASIN DEVELOPMENT,
Idaho Univ., Moscow, Agr Econ Dept.
William E. Folz.
Law and Contemporary Problems, Vol 22, No 2, pp 205-220, Spring 1957. 34 ref.

Descriptors: *River basin development, Economic impact, Water resources development, Columbia river basin, Interstate rivers, *Economic efficiency, Irrigation programs, Water demand, Hydroelectric power, Legislation, Leontief models, Input-output analysis.

An inquiry into the influence of river basin development on economic expansion can, perhaps, best be initiated by a determination of the types of resources that are likely to be created or enhanced by such development and then an evaluation of these resources as dynamic economic prime movers. This article suggests that irrigated agriculture is probably the most certain of the products of river basin development to induce economic expansion, electric power rates very high as a prime mover to economic expansion, and other by-products of river basin devepment, such as navigation, flood control, and recreation, have only negligible potential for inducing economic expansion. (R. Smith-Fla)
W69-00846

GEOLOGIC FACTORS IN COMMUNITY DEVELOPMENT AT NAPERVILLE, ILLINOIS,
Illinois State Geological Survey.
James E. Hackett.
Environmental Geology Notes, Number 22, June 1968, 16 pp, 4 fig, 11 ref.

Descriptors: Bed rock, Dolmite, Non structural alternatives, Flooding, *Impaired water quality, *Geologic investigations, *Water supply, Ground water, Low flow, Stream flow, Drainage basin.
Identifiers: Naperville (Ill), West Branch Dupage River, Spring brook.

Expansion of the city by incorporation of tracts of land for subdivision and for industrial and commercial use has resulted in expansion of community service facilities for water, sewerage disposal, and storm water drainage control. Because Naperville is surrounded by unurbanized land it will continue to grow, necessitating comprehensive plans to meet future development needs. Information on geology, ground water resources, stream flow, and extent of flooding was gathered and related to various aspects of community development. Certain significant problems become evident: construction in areas subject to flooding and areas of poor drainage; impaired water quality due to the fact that Naperville is at the downstream end of the drainage basin in the county; legal and physical hindrances prevent other sources from being used, water supply must be had from underground sources. Considering these factors recommendations for future planning policies are outlined. (Gargola-Chicago)
W69-00943

INTERGOVERNMENTAL RESPONSIBILITIES FOR WATER SUPPLY AND SEWAGE DISPOSAL IN METROPOLITAN AREAS.

Advisory Comm. on Int. Relations. Report No. A-13, Oct. 1962, 135 p, 5 tab, 72 ref, 2 append.

Descriptors: Economies of scale, Water rates, Political aspects, Water quality control, State jurisdiction, Water allocation, Legislation, *In-

teragency cooperation, Water resources management, Municipal water supply, Investment, State governments, Federal project policy, Institutional constraints.
Identifiers: Multipurpose vs. single purpose.

Discusses the problems of urban water quality and quantity, regional variations, and the difficulties of balancing and adjusting varying governmental interests. Local water problems of inadequate investment failure of individual systems, and the fragmentation of this public function are examined in detail. Various metropolitan approaches are given; arguments for a comprehensive plan include the economics of scale, equalization of water and sewer rates, and fewer unwise investments. Considered then are the political realities in relation to these approaches; the difficulties of the multi-purpose approach are discussed in comparison with the easily implemented single-purpose plans. The state's role in urban water planning is reviewed in the areas of allocation, regulation, facilitation and development. Continuing on governmental involvement suggestions for the role of the federal government in quality and quantity control are given. It is decided that the problems of water resource management are more governmental than technical; ten suggestions for future developments, with plans to implement them are then given. In conclusion, models for acts - State Water Resources Planning and Coordination Act, and Control of Urban Water Supply and Sewerage Systems are suggested. (Gargola-Chicago)
W69-00944

WATER MANAGEMENT AND URBAN PLANNING,
Lyle E. Craine.
American Journal of Public Health, Vol 51, No 3, March 1961, p 427-33.

Descriptors: Water resource management, Water supply, Project planning, Coordination, Project policy, Urbanization, Water means, Flood damage control, Water use, *Inter-agency coordination, Local governments, Public health.
Identifiers: Resources for the Future Inc., Water supply-demand, Population growth.

Solution to water problems of the future will demand a closer coordination of urban planning and water development. New requirements for planning coordination will develop: (1) increased emphasis upon intensive water management in certain urbanized areas; (2) changes in water-use patterns demanding multipurpose planning approaches; (3) demand for greater local participation in federal water management; and (4) comprehensive approach to flood problems. These are largely the product of the interaction of two factors: (1) the concentration of demand upon local water resources, and (2) the increasing value which the urbanized public attaches to water amenities. Greater involvement of local government in water management and a greater integration of water development and urban planning will be required. (Gargola-Chicago)
W69-00947

CONTROL OF LAND CONTIGUOUS TO FEDERAL RESERVOIRS,
Kansas State Univ., Manhattan, College of Architecture and Design.
Maurice Lee Miller.
Kansas Engineering Experiment Station, Special Report 51, 1964, 9 p, 1 tab.

Descriptors: *Land development, Reservoirs, Recreation, Public benefits, State governments, Project planning, *Inter-agency cooperation, Acquisition, Financing, Coordination, Legal aspects, Local governments.
Identifiers: Kansas.

Demands are increasing for recreational, residential, commercial, and industrial land uses adjacent to reservoirs. The greatest need to promote good development is adequate land use planning and subdivision control. Although each reservoir situation is different, a generalization can be made that a substantial portion of the waterfront should not be subdivided for residential purposes. Increasing public demand for recreation indicates that a portion of the waterfront and the lake itself should be reserved for these purposes. A summary of reservoir planning activities in sixteen states is given. There is a current trend for state agencies to cooperate more with federal agencies in reservoir pre-construction planning. This tends to promote coordination in providing for adequate land for public access and recreation. Specific agencies in Kansas involved in planning are listed. In summary, twelve major findings are reviewed. (Gargola-Chicago)
W69-00962

WATER SUPPLY AND POLLUTION CONTROL ASPECTS OF URBANIZATION,
Duke University, Department of Civil Engineering.
Edward H. Bryan.
Law and Contemporary Problems, Vol. 11, Oct. 1959, p 176-192, 2 tab, 18 ref.

Descriptors: Water value, Urbanization, Desalinization plants, Water desalting, Oxygen requirements, *Pollution abatement, *Water quality control, Waste water treatment, Water reuse, Industrial use, Water consumption, Recirculated water, Water reuse, *Water resource development, Water demand, Water supply, Waste dilution.
Identifiers: Florida, California.

Civil engineers have not been fulfilling their proper role in areas of urban planning and building technology. The very need to consider both water supply and pollution control as a single subject is illustrative of the new fields in which the civil engineer must work. As a background to discussion of this, the hydrologic cycle, industrial water use, and impairment of water quality is discussed. Our needs for water have sharply increased in the past years and promises to continue to increase in the future. There would be no problem in connection with water resources if wastewater could be economically treated to remove all pollutional characteristics. Discussion of pollutants, distillation, recirculation, desalinization, air pollution, and oxygen demand of water, and their possible significance in management of water quality is given. The problems of urbanization has created many of the water supply problems we now face. There is a great urgency for development of legal tools with good technical consultation in their conception and enforcement. Reorganization of our political boundaries to permit more effective utilization of regional water resources is imperative if we are to have sufficient water resources to meet the increased urbanization of the future. (Gargola-Chicago)
W69-00963

COMPREHENSIVE RIVER BASIN PLANNING: THE ARKANSAS-WHITE-RED BASINS INTER-AGENCY COMMITTEE EXPERIENCE,
Michigan Univ., Institute of Public Administration.
Robert H. Pealy.
University of Michigan, Ann Arbor, 1959, 71 p, 37 ref.

Descriptors: *River basin planning, *Decision making, Project planning, Project purposes, *Institutional constraints, Administration decisions, Legal aspects, Financing, Secondary benefits, Political aspects, State governments, Interagency coordination, Jurisdiction, Inter-agency commission on water resources, Interstate, *River basin commissions.
Identifiers: Arkansas-White-Red River Basin Inter-Agency Committee, Arkansas River, White River, Red River.

The AWRBIAC was formed to prepare a comprehensive plan which was to be fully coordinated among the relevant federal agencies and state governments. The major effort was directed toward getting member agencies to define comprehensive river basin planning, rather than actually preparing a plan. The Legislative history of the AWRBIAC is reviewed and basic organizational and procedural forms defined. State representatives and members from designated federal agencies formed the control group, each member having veto power. This unanimity rule was the source of much difficulty in forming any definite plan. A proviso clause whereby existing structures, projects under construction, projects contemplated for future authorization or construction could not be hindered or delayed as a result of the AWR study was a constraint on the development of an independent program. These obstacles, with difficulties in financing, measurement of secondary benefits determined to a great extent the scope and character of the plan. Although the AWRBIAC agreed that a comprehensive plan is one which is fully coordinated with respect to economics and engineering, they did not succeed in making a plan which satisfied these criteria. An analysis of this failure is the main purpose of the report. (Gargola-Chicago)
W69-00964

DETERMINANTS OF PROPERTY VALUE ON ARTIFICIAL LAKES,
Wisconsin Univ., Department of Agricultural Economics.
Elizabeth L. David, and William B. Lord.
Unpublished report, Department of Agricultural Economics, University of Wisconsin, Madison, 1968. 69 p, 22 tab, 12 ref.

Descriptors: *Recreation, *Sampling, Demand, Mathematical model, Regression analysis, *Automatic Interaction Detection, Analysis, Investment.
Identifiers: Economics, *Value, *Artificial lakes.

One method of determining the benefits and costs of recreational uses of water resources is to get some measure of the market evaluation of private access to a water front. This report studied the market value of water front plots on man-made lakes (i.e., artificial lakes). The report found that recreational land is much in demand. Increases in property values means an increasing tax base. Also, increases in amounts of waterfront development means more business for the building trades, suppliers, and local businesses. Significant positive relationships were found between the amount of private shoreline property, good water quality, and higher property values. Other variables were also studied. In choosing among the alternative public investments, the higher property values resulting from variants of the characteristics of the site and the lake should be taken into account. (Grossman-Rutgers)
W69-00968

A MODEL TO ESTIMATE THE ECONOMIC EFFECTS OF WATER-BASED RECREATION PROJECTS IN LOCAL POLITICAL SUBDIVISIONS,
Wisconsin Univ., Madison, Agric. Econ. Dept.
Robert J. Kalter.
Final Rep Water Resour Center 65-005, Summer 1966. 207 p, 27 tab, 59 ref, 13 append. OWRR Project A-007-Wisc.

Descriptors: *Recreation, *Recreational facilities, *Economics, Project planning, Lakes, Streams, Rivers, Decision making, Effect, Bibliographies, *Wisconsin, Mathematical models, *Economic impact.

A study was made of the economic impact of water-based recreational activities on the local community of Walworth County in southeastern Wisconsin. General objectives of the study were to: (1) Provide a method by which the economic effects of state and federal water-based recreation projects on the economies of local political subdivisions can be determined; and (2) Begin empirical testing of the model and to illustrate its potential

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use, in conjunction with subsidiary studies, to facilitate and improve the public decision-making involved in recreational resource development. Conclusions and projections are given.
W69-00969

ALTERNATIVE ECONOMIC RESPONSES TO THE ACID MINE DRAINAGE PROBLEMS IN APPALACHIA,
Ohio State Univ., Columbus.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00972

PRELIMINARY ETHNOGRAPHIC STATEMENT OF THE CALAPOOIA RIVER BASIN,
Oregon State Univ., Corvallis.
T. C. Hogg, and R. W. Beard.
Misc Pap, 1968. 34 p, 1 map, 64 ref. OWRR Project A-002-Ore.

Descriptors: *Social aspects, *Rural sociology, *Community development, *Social values, Ecology, Social adjustments, Social change, Social impact, Social needs, Social participation, Bibliographies.
Identifiers: Ethnography.

Interviews were conducted using questionnaires and the 'openended' ethnographic technique. It was concluded that the social organization of the Calapooia both retards and is a prelude to any subsequent resource development. Regions now articulated will have the most difficult adjustment to such growth. Those adhering to a hill tradition will more rapidly acculturate than will those retaining the valley tradition. The basin's ecology is not uniform, and it is economically decentralized and disintegrating. The same factors which operate in the Calapooia plague the underdeveloped regions and countries of the world.
W69-01004

ECONOMICS OF WATER CONSERVATION WITH MONOMOLECULAR FILMS: PART I,
Waterloo, Univ., Ontario, Canada.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-01017

THE ECONOMIC IMPACT ON SOUTHWESTERN WYOMING OF RECREATIONISTS VISITING FLAMING GORGE RESERVOIR.
Wyoming Univ, Laramie, Wyoming, Agricultural Experiment Station.
Rodney C. Kite, and Willard D. Schutz.
Research Journal 11, Agr. Exp. Stat., University of Wyoming, Aug 1967. 24 p, 12 tab, 5 ref, 2 append.

Descriptors: *Leontief models, *Expenditures, Multiplier effects, *Economic impact.
Identifiers: Economics, *Recreation, *Wyoming.

The economic impact and the multiplier effect of expenditures on the following sectors is analyzed: gasoline service stations, food and beverage, and other retail. A detailed statistical breakdown is given of the origin of the recreationists, if their primary purpose was to visit the reservoir, the primary activity they engaged in while at the reservoir, the number and composition of their party, the length of stay, and the distance travelled. The information was obtained through interviews during June, July, and August of 1965. The impact, both direct and indirect, of expenditures on the economic system in the area was derived by use of the multiplier matrix. The multipliers indicate how much economic activity will be generated in a particular sector of the economy by one dollar of new income. The input-output model, which includes the multiplier matrix, is explained in the appendix. (Grossman-Rutgers)
W69-01061

WATER USES IN THE NORTH PLATTE RIVER BASIN OF WYOMING.
Wyoming Univ, Laramie, Wyoming, Agricultural Experiment Station.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-01062

ON THE SOCIAL RATE OF DISCOUNT.
Princeton Univ, Princeton, N.J.
William J. Baumol.
Am Econ Rev, Vol 58, No 4, pp 788-802, Sept 1968. 16 ref.

Descriptors: *Resource allocation, *Discount rate, Planning, Return, Investment, Taxes, Risk.
Identifiers: *Social rate of discount, *Opportunity cost, Public investments, Time preference, Externalities.

The opportunity cost criterion for the appropriate rate of discount on government investments is utilized to examine the implications of factors such as risk and taxes for the discount rate. While the opportunity cost of resources drawn from consumers may approximately be the corresponding rate on government bonds, the opportunity cost of resources drawn from the corporate sector is generally considerably higher. Thus a higher discount rate should apply to all resources withdrawn from the corporate sector whether they would have been used by the firms to produce consumers' goods or producers' goods. It is also shown that the law of large numbers approach to risk also makes for a relatively high social discount rate. Finally, it is pointed out that those who advocate low discount rates on grounds of social responsibility overlook present social needs and pay attention to those of the future. They must assume, perhaps implicitly, that the present investments required for purposes such as slum clearance and education have a relatively low priority in comparison with the needs of our descendants (who will almost certainly be substantially wealthier than we are). (Seneca-Rutgers)
W69-01066

THE INTERINDUSTRY WATER CONTENT MATRIX: APPLICATIONS ON A MULTIREGIONAL BASIS.
California Univ, Berkeley.
Everard M. Lofting, and H. Craig Davis.
Water Resources Research, Vol 4, No 4, pp 689-695, August 1968. 25 ref.

Descriptors: Input-output analysis, Regional analysis, Planning.
Identifiers: *Interindustry, *Water content matrix, *Multiregional, Leontief inverse, Technical coefficients, Water use multiplier.

An interindustry or input-output model represents the structural interdependence of a national or regional economy. The inverse matrix of such a model reveals in each cell the amount of a given commodity necessary for the delivery of a unit of output of product to final demand. Usually, such entries are in dollar terms; however, these values can be converted to factor requirements such as man-years of labor or acre-feet of water. Such matrices are then termed 'factor content' matrices. Some of the specific uses of a 'water content' matrix constructed from a multiregional input-output model of western states and a vector of water use coefficients are discussed. Suggestions are made concerning improvement of the present water use data and the applicability of these data to regional water planning. (Seneca-Rutgers)
W69-01067

BROAD HORIZONS IN WATER RESOURCE PLANNING AND INVESTMENT,
Resources for the Future, Washington, D. C.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01069

CAN WE SOLVE OUR WATER PROBLEMS,
Resources for the Future, Washington, D. C.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01070

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
Water Resources Engineers, Walnut Creek, California.
Denny S. Parker, and James A. Crutchfield.
Water Resources Research, Vol 4, No 2, pp 233-246, April 1968. 9 fig, 2 tab, 6 ref.

Descriptors: *Water quality, *Benefits, *Costs, *Water pollution, Management, Planning, Time, Discount rate, Growth rates.
Identifiers: Long-term benefits, Social cost, Benefit function, Present worth, Present worth of the benefit.

Economists, in evaluating the long-term benefits in public works projects, have traditionally held that long-term benefits will contribute little to the total present worth of the benefits accrued over the life of the project. It is shown, however, that the long-term social cost resulting from projects that cause water pollution cannot be neglected or assumed away in the many practical cases where 'amenity' demands of good water quality in a project's area of influence are significant. (Seneca-Rutgers)
W69-01071

REGIONAL ECONOMIC INTERDEPENDENCIES AND WATER USE.
Resources for the Future, Inc., Washington, D C.
L. M. Hartman, D. A. Seastone, Allen V. Kneese, and Stephen C. Smith.
Water Research, pp 215-231, Johns Hopkins Press, Baltimore, 1966. 17 p, 4 fig, 2 tab, 10 ref, 1 append.

Descriptors: *Water utilization, *National income, *Water transfer, Welfare, Efficiencies, Unemployment, Timing, Colorado, Region, Input-output analysis, Resources, Homogeneity, Diseconomies of scale, Capital mobility, Labor mobility.
Identifiers: *Interdependencies, Free-market, *Externalities, *Income effects, Immobilities, Sunk-capital, Agricultural multiplier.

This paper analyzes the economic aspects of the physical and economic interdependencies associated with water use and identifies those effects which have welfare implications. The analysis suggests procedures which would allow the 'water market' to operate in a more efficient manner. The study indicates that certain income externalities exist in water transfer situations and examines the implications of immobilities and unemployment of water transfers that can change national income. Thus, a basis for policy considerations is provided in the planning context and, also, for judging the efficiency of free-market institutions. Unemployment in a water buying area appears to have potentially greater significance on regional income than immobilities in the water losing sector. The timing of water transfers is an important consideration related to the magnitude of sunk-capital facility immobilities and their effect on efficient transfers. The loss of income and adjustments in the public sector are neglected aspects of this problem. Northern Colorado regional input-output model measures of some of the interdependency income effects are presented. (Seneca-Rutgers)
W69-01072

RECREATION BENEFITS FROM WATER POLLUTION CONTROL,
California Univ., Berkeley, California.
Joe B. Stevens.
Water Resources Research, Vol 2, No 2, pp 167-182, Second Quarter 1966. 3 fig, 2 tab, 25 ref.

Descriptors: Demand, *Recreation, Demand schedule, Sports fishing, *Water quality, *Water pollution control, Water pollution effects, Water

pollution, Social value, Oregon, Methodology, Benefits.
Identifiers: Yaquina Bay, Human behavioral relationships, Consumers, *Recreational benefits.

A methodology for estimating direct recreational benefits from water pollution control was developed through a model of biological and behavioral relationships involved in sports angling. A biological production function was envisaged between inputs of angling effort and the output, or yield, of fish taken. The marginal product, angling success per unit of effort, was taken to represent the 'quality' of the recreational experience. Water pollution would cause deterioration in dissolved oxygen temperature or toxicity characteristics of water, thus shifting the production function downward and causing reductions in angling success, angling effort, and the recreational value of the fishery. Demand equations and 'success-effort' elasticities were estimated for three estuarial sports fisheries, and the methodology was illustrated by means of an assumed reduction in angling success. The direct recreational benefits were identified as the consumer surplus that would result from the prevention of water pollution. (Seneca-Rutgers)
W69-01074

RECREATIONAL BENEFITS OF WATER RESOURCE DEVELOPMENT,
California Univ., Berkeley, California.
Leonard, Merewitz.
Water Resources Research, Vol 2, No 4, pp 625-640, Fourth Quarter 1966. 7 fig, 1 tab, 20 ref.

Descriptors: *Demand schedule, Demand recreation, Regression analysis, Benefits, Statistical methods, Water resource development, Model studies, Missouri, Methodology.
Identifiers: *Recreational benefits, *Consumers' surplus, Attendance prediction model, Lake of the Ozarks, Niangua Arm.

Recreation is a purpose of water resource development that should be considered in project evaluation. A demand curve was simulated for recreation at the Lake of the Ozarks in Niangua Arm County, Missouri. Using distance as a proxy for price, the consumers' surplus implied by the demand curve was measured. Cross-sectional variations in associated costs simulated price variations for recreation, a non-market commodity. The basic data necessary for predicting recreation demand are the county's population, population density, distance from the site, and mean income. Variables such as mobility and the availability of alternative recreational opportunity did not appear to be useful in the forms in which they were available. Some relevant considerations in the design of the sample survey are indicated. (Seneca-Rutgers)
W69-01075

RESOURCE ALLOCATION AND THE PUBLIC SECTOR,
Yale Univ., New Haven, Connecticut.
Duncan K. Foley.
Yale Econ Essays, Vol 7, No 1, pp 45-98, Spring 1967. 7 fig, 13 ref.

Descriptors: *Resource allocation, Benefits, *Taxation, Progressive taxes, Tax rate, *Welfare, Political aspects, Social aspects, Government.
Identifiers: *Public goods, Private goods, Preferences, *Equilibrium theory, *Pareto optimality, Utility functions, Proportional taxes.

This essay develops a theory of resource allocation and competitive equilibrium for economies with public goods. Public goods are defined as commodities and services of which every person in a society consumes the total produced. Examples are police protection and defense. Competitive equilibrium is generalized to include a government which is at least minimally responsive to the preferences of citizens. The efficiency prices associated with a Pareto optimum are interpreted to demonstrate the nonexistence of any Pareto optimum, and of an unanimously favored alternative tax and expenditure proposal. The existence of an equilibrium with a proportional income or wealth tax is proved. A brief discussion of the problem of interpersonal utility comparisons is presented and an operational definition of equitable allocation is proposed. The political stability of certain common tax structures, including progressive income taxes in a society with majority rule is investigated and an extension of the theory to the existence of local public goods and the problems of regional government is presented. (Seneca-Rutgers)
W69-01078

BOND EVALUATION AS A DECISION UNDER CERTAINTY, RISK OR UNCERTAINTY,
Norweigan School of Economics and Business Administration, Norway.
C. M. Schilbred.
The Swedish Jour Econ, Vol 70, No 1, pp 43-56, March 1968. 2 fig.

Descriptors: *Value, Decision making, *Risk, Probability.
Identifiers: *Bonds, *Redemption date, Lottery bond, Series bond, Annuity bond, Option bond.

According to whether a bearer's bond has been issued under the provision that its future redemption is to take place at a fixed date, in one of a series of lotteries, or at the option of the debtor, the investor's valuation of the bond may be described as a decision under certainty. As investors in bonds are internationally and commonly confronted with such decision problems and are aware of the relevant properties, this is a field where empirical studies of the investor's treatment of risk and uncertainty can be undertaken. Some cursory observations of the applied decision rules are analyzed. (Seneca-Rutgers)
W69-01079

ON RESERVOIR SITE PRESERVATION POLICY,
Resources for the Future, Washington, D C.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01080

PRIVATE CAPITAL INVESTMENT: A CASE-STUDY APPROACH TOWARDS TESTING ALTERNATIVE THEORIES,
Leeds Univ., Great Britain.
C. M. Cannon.
Jour Indus Econ, Vol XVI, No 3, pp 186-195, July 1968.

Descriptors: Diversification, *Investment, Profit, *Capital, Expenditures, *Risks forecasting, Demand.
Identifiers: Liquidity, Expand production, Production process, Factory capacity, *Accelerator theories.

This paper considers information collected and used by four businesses, and then formation of expectations during their appraisal of proposals for four factory investments. The businesses were very large, each with an international reputation. Four large capacity expansion investments were selected for further study out of 14 investments selected by these firms for investigation by the Manchester University Center for Business Research. The case-study evidence was consistent with an absolute sales-capital stock form of accelerator relation, if the subjective character of expectations of market size is admitted. On the other hand, if a marginalist approach admits rigidities in expectations and imperfections in planning and financial control, it will provide a similar prediction to that of an accelerator relation: changes in the ration of expected absolute sales to capital stock will determine changes in the level of private capital investment. The evidence also suggests that this accelerator relation was abruptly recognized as inadequate by businessmen who were experiencing a downturn in the business cycle; only then was attention turned to a financial summary of the worth of expenditure proposals. (Seneca-Rutgers)
W69-01081

OPTIMUM INVESTMENT IN STRUCTURAL FLOOD CONTROL,
Rutgers, The State Univ., New Brunswick, New Jersey, Water Resources Research Institute.
William Whipple, Jr.
Journal of the Hydraulics Division, ASCE, Vol 94, No HY6, Proc Paper 6238, pp 1507-1515, November 1968. 9 p, 2 fig, 2 tab, 9 ref.

Descriptors: *Cost-benefit analysis, *Flood control, Flood plain zoning, Flood plains, Flood plain insurance, *Flood damage, Investment.
Identifiers: Structural improvements, Intangible damages, Municipal area, Corps of Engineers, *Project-induced growth, Partial control.

National flood damages have been increasing, despite extensive construction programs, due largely to economic encroachments on the flood plain. This situation calls for a reconsideration of flood control economics. Much of this encroachment occurs as a result of the areas being protected by flood control projects and may be described as project induced. Analysis of project-induced damages indicates that, contrary to certain critics, only quite high degrees of flood protection can be justified economically. As a result of this approach, benefit-cost ratios as usually computed should be reduced. Basin-wide reservoir systems inherently involve extensive partial flood protection, due partly to the extension of effects downstream and partly to the continual economic development in flood plain areas lower than those to which adequate protection is afforded. Therefore, some way must be found to control project-induced growth downstream, as an adjunct of reservoir systems. This could be done by general reservation of floodways downstream of flood control reservoirs. (Seneca-Rutgers)
W69-01083

OPTIMAL TAXING OF WATER POLLUTION,
Chicago Univ., Illinois.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-01084

AN ASPECT OF PROJECT-SELECTION DURABILITY VS. CONSTRUCTION PERIOD,
Peterhouse College, Cambridge Univ, Great Britain.
Amit Bhaduri.
Econ Jour, Vol LXXVIII, No 310, pp 344-348, June 1968. 1 fig.

Descriptors: *Durability, Capital, Investment.
Identifiers: *Construction period, *Gestation lags, Time rate of discount, Fixed assets, Capital-output ratios.

The question is examined of balancing the economic 'advantage' of longer durability against the 'disadvantage' of longer construction-period in selecting among alternative projects producing a given commodity. Assuming that the time-path of the investment-fund to be alloted for installing projects is known and also, that time-path of investment is rising at a steady percentage rate over time, the paper establishes the following result: a faster-growing economy may find it more advantageous (other things being equal) to install projects of shorter durability and shorter construction-period. The main point of the paper is to indicate how choices involving time in project evaluation can be settled through the assumed rate of growth of investment, rather than the hazy and less operational notion of a 'social rate of time-discount.' (Seneca-Rutgers)
W69-01085

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TAX AND INCOME STABILIZATION,
Trinity College and Institute of Public Administration, Dublin, Ireland.
J. A. Bristow.
Econ Jour, Vol LXXVIII, No 310, pp 299-311, June 1968. 1 fig.

Descriptors: *Stabilization, Investment, Consumptive use, *Tax rate.
Identifiers: *Cyclical fluctuations, *Policy lag, Revenue, Dividends, Income tax, Indirect taxes, Marginal propensity to consume.

An attempt was made to assess the effects on cyclical variations in the rate of income growth in the United Kingdom (1955-1964) of one component of stabilization policy-tax changes. First a quantitative model was constructed. This model was to show the effects of various types of tax change, on a quarterly basis. The effects of all tax changes 1955-64 were estimated, and these effects were deducted from the actual quarterly outcome of four variables--Gross Domestic Product, total expenditure, consumption, and gross investment. This gave an estimate of what would have occurred if there had been no tax changes. The result was increased stability, providing some support for the view that tax changes are usually made too late to be ideal anticyclical measures. (Seneca-Rutgers)
W69-01086

EXTERNAL ECONOMIES AND SECOND-ORDER OPTIMALITY CONDITIONS,
Princeton Univ., Princeton, New Jersey.
William J. Baumol.
American Econ Rev, Vol LIV, No 4, part 1, pp 358-372, June 1964. 2 fig, 7 ref, 3 append.

Descriptors: *Optimization, Return to scale.
Identifiers: Social welfare function, Corner points, *External economies, Social cost, *Second order conditions, *Public policy.

The following propositions are demonstrated and explained: (1) an industry characterized by external diseconomies may produce an output less than the social optimum even if the economy is in competitive equilibrium and all other industries yield external economies. (2) There is no general validity to the neoclassical proposition which alleges that external benefit yielding activities will be below the optimal level. (3) The presence of externalities is likely to lead to multiple maxima in the social welfare function and to violation of the second order maximum conditions. (4) The neoclassical position referred to in (1) and (2) above is likely to fail because we may move toward a local optimum by increasing output when marginal social benefit exceeds marginal social cost. (5) Even if the second order conditions hold, the neoclassical proposition is still invalid except where marginal social costs and benefits are exactly equal for all activities but one. (6) Policy prescription is more complicated and its conclusions more ambiguous than previously thought. It is only known that some activity yields external benefits (or diseconomies) of unspecified magnitude, from this alone it is impossible to determine whether the activity should be expanded or contracted. (Seneca-Rutgers)
W69-01087

IS PUBLIC INTERVENTION IN WATER RESOURCES DEVELOPMENT CONDUCIVE TO ECONOMIC EFFICIENCY,
Resources for the Future, Inc., Washington, D. C.
John V. Krutilla.
Natural Resources Jour, Vol 6, No 1, pp 60-75, January 1966. 1 tab.

Descriptors: *Efficiencies, *Welfare, *Water resources development, Institutions, Prices, Marginal costs, *Cost-benefit analysis, *Water management.
Identifiers: *Public intervention, Indivisibilities, Marginal social product, Marginal social cost, Coupon rates, *Reimbursement policy.

Observations on the institutional machinery of public intervention at the present time merit serious consideration when the question is posed with respect to the sufficiency of public intervention for the improvement of efficiency in the water resource development field. A concerted effort should now be made to review the character and capabilities of existing agencies, to identify barriers to improved performance, and to address the problem of organizing a capability consonant with present and future requirements. Not a little could be learned from the pioneering work in water quality management by the cooperative water quality management associations in the Ruhr, or the integration of investment planning, design criteria and pricing policy of Electricite de France. Doubtless a similar spirit of innovation in the water resources field in the United States would add a considerable measure of assurance that public intervention would be sufficient as well as necessary to improvement of efficiency in water resources development programs. (Seneca-Rutgers)
W69-01088

ISOLATION, ASSURANCE AND THE SOCIAL RATE OF DISCOUNT,
Delhi Univ., India, Delhi School of Economics.
Amartya K. Sen.
Quart Jour Econ, Vol LXXXI, No 1, pp 112-124, February 1967.

Descriptors: Consumptive use, Time, Return.
Identifiers: Zero-sum game, *Social rate of discount, Optimum savings, Social contract, *Isolation paradox, *Assurance problem.

Recent discussions on the relationship between private and social rates of discount have been concerned with a special application of a very general problem, this being a N-person extension of the 2 person non-zero sum game of the 'Prisoners' Dilemma.' In the first section the nature of this general problem (the isolation paradox) is studied. In the remaining three sections the application of this general framework to the question of optimum savings and the social rate of discount is examined. In particular, Lind's criticism of Marglin's analysis of the divergence between the social and private rates of discount is examined. Finally, the question of the future generation being much richer (on the average) than the present generation is studied as a ground for an objection that has been raised in the literature against chances of the occurrence of the 'isolation paradox.' It is shown that a change in the average wealth of the future generation vis-a-vis that of the present generation leaves the possibility of the 'isolation paradox' completely unchanged. (Seneca-Rutgers)
W69-01089

CONVENTION AND LIMITATION IN BENEFIT-COST ANALYSIS,
Stanford Univ., Stanford, California. Food Research Institute.
Richard J. Hammond.
Natural Resources Jour, Vol 6, No 2, pp 195-222, April, 1966.

Descriptors: Prices, *Cost-benefit ratio, *Cost repayment.
Identifiers: Bureau of Reclamation, Infallibility, Secondary benefits, Market, Maximization.

Official doctrine on benefit-cost analysis presents contradictions of principle and mistakenly neglects administrative considerations. The contradictions appear to be due to misunderstanding of the role of theory in economic questions, whereby statements of principle having no relation to empirical fact are treated as maxims of conduct, and theorems based on the assumption of perfect foresight are applied in a world where the future is inherently uncertain. Critics of present governmental practice habitually argue for a greater recourse to benefit-cost analysis in the name of efficiency. They forget that economics cannot go beyond defining efficiency to ensuring it. On the contrary: the question is rather whether the analysis is not being overdone, in the belief that it can somehow dispense with the need for political and administrative decisions. What is needed is a candid recognition of its inherent limitations: that it cannot forecast the future and is incapable, by reason of its dependence on policy assumptions, of becoming the basis of policy decisions. It is a useful administrative tool in limited applications, not a solvent for major economic problems in the field of resource use. (Seneca-Rutgers)
W69-01091

CONCLUSIONS ABOUT WATER SUPPLY,
Rand Corporation, Santa Monica, California.
Jack Hirshleifer, James C. DeHaven, and Jerome W. Milliman.
Water Supply Economics, Technology and Policy, Univ. of Chicago Press, 1963, pp 357-367.

Descriptors: Water supply, Technology, *Administrative decisions, Investment, Pricing, Welfare, Attitudes, Social values, Market, Adoption of practices, Water law, Economic evaluation, Institutional constraints, Political aspects, Attitudes, Federal governments, State governments, Local governments.
Identifiers: Decentralized decision making, Alternatives.

The economics, technology and policy of water supply are examined. The major purpose was to show by argument and example that the correct application of economic principles will produce the greatest efficiency in water supply procurement and utilization in relation to and in competition with all other desires of the community. In this country major water investments are typically prematurely undertaken, resulting in overinvestment in water supply. Reasons for this are discussed. Decentralized decision making is the preferred manner, with private, local, state and federal decision making ranked in that order. Much of the present misuse of water within the sphere governed by the market can be traced to imperfections in water law and its administration. Suggestions for improvement are given. The importance is stressed of considering a wide range of planning alternatives. Significant new developments in technology are also reviewed. In conclusion the 'water is different' philosophy is criticized and water resources are shown to be an economic resource similar to land and should be treated economically, and politically in the same manner. (Gargola-Chicago)
W69-01095

WATERSHED DEVELOPMENT IN THE COMMUNITY FIELD,
Mississippi State Univ, Water Research Institute; Social Science Research Center, State College, Mississippi.
Kenneth P. Wilkinson.
Rep, Mississippi State Univ, 1968, 11 p, 14 ref.

Descriptors: *Watershed development, Community development, Social aspects, Sociology, Social impact, Social change, *Social participation, Water resources development, Social needs, Social values, Social behavior, Local governments, *Planning, Social function.
Identifiers: Dynamic field, Field theory.

The paper is concerned with the interaction between local and extralocal social structures and processes using watershed development as an area of investigation. The stated objective of the paper is to provide both a logical and empirical basis for the development of hypotheses action. The framework developed would be applicable to urban and other local contexts, including metropolitan areas. Community is viewed in terms of social field theory. The community field is characterized by actors, associations and activities, and has a distinct direction or focus. Distinction is made between societies according to the degree of coordination or integration among interest field and among the interest fields within a given local society. Hypotheses are

advanced relating levels of task accomplishment and four types of community-agency fields: internally consistent fields; coordination action style; internally inconsistent fields; and autonomous action style. Two empirical community studies are reviewed and interpreted in light of the hypotheses. (Abodeely-Chicago)
W69-01096

MUNICIPAL WATER SUPPLY,
Rand Corporation, Santa Monica, California.
Jack Hirshleifer, James C. DeHaven, and Jerome W. Milliman.
Water Supply, Economics, Technology and Policy, Univ. of Chicago Press, 1963, pp 175-181, 2 tab, 7 ref.

Descriptors: *Municipal water supply, Costs, Evaluation, Wastewater treatment, *Water distribution, Water consumption, Project planning, Optimum development plans, Interest rates, Sewerage systems, Water transfer, Unit costs.
Identifiers: Economic constraints.

General characteristics of municipal water supply systems are: (1) sources of raw water, (2) transmission system, (3) treatment facilities, (4) distribution network, (5) pumps and storage capacity, (6) valves, hydrants, and meters to control and measure flow. The total cost of the municipal water system lies in three major areas: (1) production, transmission, and treatment costs; (2) distribution costs; and (3) fire protection. Investment and operating costs differ from city to city. Water treatment costs are discussed in relation to capacity and interest rates. The choice of a transport system is influenced by terrain features, total capacity, length of the system, and the relative costs of the alternative types of elements and of pumping. No generalized cost information has been developed relating to large water transmission systems but a discussion of specific cost factors is given. The economic considerations of consumptive losses in public systems are reviewed and alternatives for improvement suggested. (Gargola-Chicago)
W69-01097

HUMAN RESOURCES AND REGIONAL DEVELOPMENT: SOME LESSONS FROM FRENCH EXPERIENCE,
Kentucky Univ., Lexington.
Niles M. Hansen.
Southern Economic Journal, Vol 34, No 1, pp 123-132, July 1967. 1 tab.

Descriptors: *Human resources, Migration, Education, Training, Land development, Economics.
Identifiers: France, *Regional development.

The underdevelopment of France's agricultural regions of the West has been attributed to the attractiveness of the Paris region and to the need for land reform and larger farms in the West. Although these factors are important, a more fundamental problem is the lack of investment in the quality of human effort. While trying to maintain a large population in the lagging agricultural regions, French policy in past years has neglected human resource investment. In recent years more emphasis has been placed upon human resource investment, but this emphasis has not been strong enough. Both theoretical propositions developed previously by the author and the data considered in the article support, by opportunity cost criteria, the case for emphasizing human resource development. (Seneca-Rutgers)
W69-01099

WEALTH AND INCOME DISTRIBUTION, INVESTMENT, AND ECONOMIC DEVELOPMENT,
Wayne State Univ., Detroit.
Hector Correa.
Southern Econ Jour, Vol XXXIV, No 2, pp 283-285, October 1967.

Descriptors: Capital, Credit, *Investment, Profit, *Financing.
Identifiers: Leisure, Capital intensive, *Income distribution, *Concentration of wealth, Management, *Economic development.

This paper attempts to show how a high concentration of wealth and income influences the behavior of savers and investors and, therefore, economic growth. The relationships presented are to be considered as a hypothesis, which could be validated by empirical research. However, there is at present a lack of available data. As a substitute it is shown that several characteristics of the developing countries in which conditions of high concentration of income are assumed to exist can be considered logical consequences of the hypotheses presented. (Seneca-Rutgers)
W69-01103

CRITERIA FOR PUBLIC INVESTMENT: SOME SIMPLIFYING SUGGESTIONS,
London School of Economics, Great Britain.
E. J. Mishan.
Jour Pol Econ, Vol 75, No 2, pp 139-146, April 1967. 1 fig, 8 ref.

Descriptors: *Interest rate, *Discount rate, *Investment, Financing, *Benefits, Constraints.
Identifiers: Social opportunity cost, Opportunity yield, Social rate of time preference, Present value, Perpetuity, Market yield.

An appropriate public investment criterion, under conditions of certainty, requires that the present value of an investment project exceed its social opportunity cost. Recently three features have been built into such models, each of which, within a full employment framework in which the social rate of time preference exceeds the market yield, can be shown to be invalid: (1) a distinction between debt finance and tax finance, (2) discounting future returns at the social rate of time preference as a necessary requirement, and (3) reinvestment of some fixed proportion of the primary, secondary, and subsequent stream of returns at the market opportunity yield. The criterion is simplified by a correct allocative approach. In the particular case where all benefits are revenues the public investment criterion is met if the present value of the stream of benefits and outlays is positive--when discounted at the existing market opportunity yield and not the social rate of time preference. (Seneca-Rutgers)
W69-01104

RESTRAINTS AND THE ALLOCATION OF RESOURCES,
Kent Univ., Canterbury, Great Britain.
Charles Kennedy.
Oxford Econ Papers, Vol 20, No 2, pp 195-207, July 1968. 2 fig, 16 ref.

Descriptors: Investment, Expenditures, Financing, *Resource allocation, Constraint, Growth rates, *Import.
Identifiers: *Saving, Scarcity, *Underdeveloped countries, *Foreign exchange, Numeraire, Production function, *Substitution.

The Keynesian proposition that saving is not a resource is valid not merely for the case of underutilized resources. Its general application arises from the negative character of saving. A simple version of the theory of dominant restraint holds that there may be two possible restraints on the growth of output but that only one will be operative at any one time. The objection to this theory is that it unrealistically presupposes a complete lack of substitutability between imports and capital. The possibility of substitution between imports and capital enhances the importance of foreign borrowing in facilitating economic growth, and makes any treatment of saving as a quasi-resource illegitimate. The treatment of saving as a numeraire for valuing other resources is also criticized, for most countries foreign exchange would be more appropriate. While the necessity to consider more than one scarce resource has already been proved, it is suggested that a developing country would do better by using a crude 'foreign exchange' criterion than by using a more sophisticated approach that included saving (capital) as one of the resources. (Seneca-Rutgers)
W69-01106

WELFARE MAXIMIZATION: THE SIMPLE ANALYTICS WITH PUBLIC GOODS,
Rice Univ., Houston, Texas.
Charles E. McLure, Jr.
Canadian Jour Econ, Vol 1, No 3, pp 633-639, August 1968. 2 fig.

Descriptors: *Resource allocation, Alternative costs, *Optimization.
Identifiers: *Pareto optimality, Jointness in supply, Conflict curve, *Public good, Income redistribution, *Social welfare function.

This note attempts to demonstrate how public goods can be incorporated in the analysis of welfare maximization. One major change is made in the marginal conditions for Pareto optimality when a public good is introduced. The box diagram and conflict curve are considerably altered, the marginal conditions for over-all efficiency become equality of the marginal rate of transformation and the sum of the marginal rates of substitution for the two individuals, and there are no marginal conditions for efficiency in exchange. This is a crucial difference. Voluntary exchange does not occur since each person realizes that his consumption of the public good is largely independent of his contribution to its provision. Because of the impossibility of trade in the public good, the market does not assure that the optimal amount of the public good is produced and the 'invisible hand' fails to achieve even the marginal conditions necessary to maximize social welfare. (Seneca-Rutgers)
W69-01107

OPTIMAL ECONOMIC GROWTH AND DISTRIBUTION AND THE SOCIAL UTILITY FUNCTION,
McGill Univ., Montreal, Canada.
A. Asimakopulos.
Canadian Jour Econ, Vol 1, No 3, pp 540-550, August 1968.

Descriptors: *Optimization, Population, Marginal productivity.
Identifiers: Biological interest rate, *Intertemporal allocation, Social welfare function, *Growth path, *Intergeneration distribution.

The choice of social utility functions for intergeneration distribution and intertemporal allocation should be made after examination of the results of their application. The Lerner-type function which takes into account group size was preferred for the first purpose, but a function which makes no allowance for population size should be used for the second purpose if fairness to all is a criterion of policy. This function can, however, display positive time preference. These two social utility functions are not inconsistent; they are constructed to deal with different tasks and can both be used by the same planning board. The justification for using a Lerner-type social utility function for intergeneration distribution is not that it gives the same results as the hedonistic function described in the article, but that it prevents discrimination between individuals in different generations which is inconsistent with individual preferences and production conditions. Lerner judges this result to be fair to all individuals in the circumstances of the particular problem. Samuelson's optimum overcompensates for the discrimination over time, that it is purportedly trying to avoid, by giving a consumption bonus to the individuals living close to the terminal period of the plan. (Seneca-Rutgers)
W69-01108

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THE EVOLVING ROLE OF THE HYDROLOGIST IN WATER RESOURCE DEVELOPMENT.
Utah State Univ, Logan.
Dean F. Peterson.
Proc Intl Symp Hydrol, Fort Collins, Colo, pp 38-45, Sept 1967. 8 p, 1 ref. OWRR Project A-999-Utah.

Descriptors: Conferences, Water resources, Water pollution control, *Water resources development, Social aspects, Water conservation, *Hydrology, Hydraulics.

This is the welcome address to the International Symposium on Hydrology, Fort Collins, Colorado, Sept 6, 1967. The scope and objectives of the symposium are outlined. The relation between hydraulics and hydrology is discussed. Water resource development is a social process and must be based primarily on social objectives rather than on technological or engineering opportunities.
W69-01117

WATER RESOURCES PLANNING STUDIES OKLAHOMA AND ARKANSAS.
Oklahoma State Univ, Stillwater.
A. F. Gaudy, Jr.
Water Resour Planning Studies, Prog Rep, Oklahoma State Univ, Feb 1968. 20 p, 5 fig, 5 tab. OWRR Project B-006-Okla.

Descriptors: *Water resources, Planning, Water allocation (Policy), Long-term planning, Coordination, Water rights, Water utilization, *Water supply, *Equitable apportionment, *Interstate compacts, Oklahoma, Arkansas.
Identifiers: *Arkansas River.

A study is in progress to assess the water resource available in that portion of the Arkansas Basin in northeastern Oklahoma. The study involves evaluation of five sub-basins (Spavinaw Creek, Illinois River, Lee Creek, Poteau River, and the Arkansas River) with respect to flood and drought flows. One of the aims of the work is to provide accurate estimates of the quantity of water available in these sub-basins for use by agencies of the states of Oklahoma and Arkansas in apportioning the joint water resources in accordance with available conservation storage. In the present report, the Poteau River Basin and the main stream of the Arkansas River are considered. Floods occurring in the entire study area were studied for magnitude and frequency with special emphasis on the problems created due to the short period of available record. For low flow analysis, a Markov Chain Model was applied to render the area hydrologically stable, preserving the essential statistical characteristics of the record, and the results obtained using this model are advocated as the basis for conservation storage. Available information pertaining to water quality, coupled with the water quantity analysis, will provide useful knowledge for further development and regional planning with respect to the water resource.
W69-01140

AGRICULTURAL RESOURCES RELATED TO WATER DEVELOPMENT IN TEXAS,
Texas Agricultural and Mechanical Univ, College Station.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-01143

THE HUMAN FACTOR AND CHANGES IN WATER USAGE PATTERNS,
Utah State Univ, Logan.
H. Bruce Byland.
Water Resour Res, Vol 2, No 3, pp 365-369, Third Quart, 1966. 5 p, 8 ref. OWRR Project A-001-UTAH.

Descriptors: *Water utilization, Economics, *Social change, Social needs, *Phychological aspects, Social aspects, *Attitudes, Decision making, Laws, Civil engineering, Economic impact, Utah, Water resources development, Economic justification, Project planning.
Identifiers: Human relations, Bear River Project.

This paper reports on preliminary work of a study dealing with cultural, social organizational, and social-psychological factors associated with a proposed change in water usage patterns. Moves and counter moves related to opposition to a proposed Bureau of Reclamation development on the Bear River in Utah, are used as a focal point. Results manifest the expected opposition: general opposition to change at a covert emotional level, more reasoned opposition by individuals and groups with a vested interest (economic, political, and social) and apparent tactics of vested interest groups to sway public opinion. Opposition to the project developed, was organized and operating 19 months before a committee was organized to promote the project. There were over 1-1/2 times as many articles in newspapers against the project as there were articles on factual information and those that were for the project. Conclusions were that more research in the human aspects of water use and organization for social engineering to augment civil engineers are imperative if our water resources are to be adequately developed.
W69-01144

MULTIDISCIPLINARY RESEARCH AS AN AID TO PUBLIC POLICY FORMATION,
Virginia Polytechnic Institute, Blacksburg.
Jabbar K. Sherwani, Emil J. Gumbel, and Robert V. Thomann.
Water Resour Res Center, Blacksburg, Dec 1965. 68 p, 7 fig, 2 tab, 18 ref. OWRR Project A-999-VA.

Descriptors: Optimum development plans, Decision making, Economic efficiency, Social impact, Systems analysis, Hydrology, Estuarine environment, *Water resources, *Water pollution, *Water policy.

Purpose of the seminar was to stimulate interest in multidisciplinary research in water resources, especially among disciplines traditionally inactive in the field, by showing the increasing number of research opportunities and needs in water resources. Four papers were presented during the seminar: 'Optimal Water Use - A Multidisciplinary Approach,' by Jabbar K. Sherwani; 'Survey of the Theory of Extremes as Applied to Hydrology,' by Emil J. Gumbel; 'Estuarine Water Pollution Control Via Systems Analysis,' by Robert V. Thomann; and 'Multidisciplinary Research on an Estuarine Engineering Project,' by William J. Hargis, Jr.
W69-01148

WATER RESOURCES PROGRAMS IN VIRGINIA,
Virginia Polytechnic Institute, Blacksburg.
William R. Walker.
Water Resour Res Center, Bull 4, Oct 1966. 235 p, 8 fig. OWRR Project A-999-VA.

Descriptors: Water pollution, Water quality control, Recreation, Drainage engineering, Erosion control, Decision making, Runoff, *Water resources, *Virginia, Forecasting, Industrial wastes, Industrial water, Streamflow forecasting.

A symposium on Water Resources Programs in Virginia brought together representatives of various agencies, commissions, and citizens groups who were involved in the planning and executing of water-related activities in the Commonwealth. Purpose of the seminar was to investigate past and present programs of these agencies and groups in order that future planning might be better coordinated, duplication of effort minimized, and freer exchange of ideas fostered. Reports were presented by federal and state agencies and local groups including the U. S. Army Corps of Engineers, Virginia State Water Control Board, Virginia Department of Health, Cooperative Extension Service, Virginia Soil and Water Conservation Commission, Commission on Outdoor Recreation, Roanoke River Basin Association, James River Basin Association, Interstate Commission on the Potomac River Basin, Tennessee Valley Authority, Department of Health, Education, and Welfare, U. S. Geological Survey, and Virginia Institute of Marine Science. (W. R. Walker-Va Tech)
W69-01149

COMPREHENSIVE RIVER BASIN PLANNING: THE LOWER MEKONG EXPERIENCE,
Wisconsin Univ, Madison.
W. R. Derrick Sewell.
Rep, Water Resour Center, June 1966. 26 p, 4 fig, 4 tab, 26 ref. OWRR Project A-999-WIS.

Descriptors: *River basins, *River basin development, *Water resources development, Project planning, United nations, Foreign countries, Water utilization, Foreign projects, Irrigation, Planning.
Identifiers: Mekong Delta, Mekong River Project.

Despite political chaos, the Lower Mekong is the first successful application of a comprehensive approach to development of an international river. It is the first instance of direct UN sponsorship of planning and development of an international river on a continuous basis, and is an outstanding example of international cooperation in scientific investigations, planning and development. The most important lesson of the Mekong experience, is that water resources planning can be an effective device for overcoming political tensions. The Mekong Committee has survived despite the political turmoil of the region. The signing of an agreement for international exchange of electric power emphasizes the sense of common purpose which water resources planning can engender.
W69-01157

POPULATION TRENDS FOR THE PLATTE AND GREEN RIVER BASINS IN WYOMING: 1890-2010,
Wyoming Univ, Laramie.
Raymond K. Kenney, and John W. Birch.
Wyo Water Resour Res Inst, Water Resour Ser 4, July 1967. 41 p, 4 fig, 7 tab, 22 ref. OWRR Project A-001-WYO.

Descriptors: *Water requirements, Forecasting, Statistical methods, Water utilization, Municipal water, *Population, *Population growth, Bibliographies, Census, Future planning, Statistics, Domestic water, *Human population, Community development, Wyoming.
Identifiers: Platte River Basin (Wyo), Green River Basin (Wyo).

Long-term population growth forecasts are made for the Green and Platte River Basins, Wyoming. Projections are made for 5-yr intervals, by counties, for 1970 to 2010. Time series census data, adjusted for county boundary changes, provided the empirical base for the projections. Projections for the entire basins were derived by summation of separate counties and from summation of population data for the entire basin. These projections will serve as a basis for estimating future residential water requirements.
W69-01158

THE 1960 CALIFORNIA WATER BOND ISSUE AND THE LOS ANGELES COUNTY ELECTRORATE: A STATISTICAL AND HISTORICAL ANALYSIS,
California Univ, Los Angeles.
Dwaine Marvick.
Water Resour Center, Tech Completion Rep, Nov 1967. 117 p, 14 tab, 172 ref. OWRR Project B-013-CAL.

Descriptors: *Water resources development, *California, Planning, *Analysis, Coordination, Legislation, Feasibility, *Financing, Government financing.
Identifiers: Los Angeles County (Calif.).

In 1960 a water bond referendum on the Nov ballot in Calif was approved by a slim majority. This confirmed the vast construction program authorized by the 1959 state legislature; the voters had approved the issuance of 1-3/4 billion dollars in general obligation bonds of the State of Calif. This amount was enough to complete at least one major project and enough to commit Calif to a coordinated and systematic plan for developing statewide water resources. Los Angeles county carried the day; its voters approved Proposition 1 by 56% of the votes cast. Without this margin of support from the State's largest metropolis, the water bond referendum would not have passed. Viewed from the perspective of 1967, it is desirable to clarify the sociological and political correlates of public awareness of, interest in, and willingness to support the large outlays of public funds needed for the maintenance of an adequate water supply for Los Angeles county. Such clarification is possible by appropriate statistical analysis of the electoral and demographic data for 1960 available for each of the 1297 census tracts of Los Angeles county.
W69-01161

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

AN ACT TO REGULATE WATER COMPANIES AND THE SALE AND DISTRIBUTION OF WATER WITHIN THE STATE.

Michigan Acts 1967. Act No 19, 4 p.

Descriptors: *Michigan, Legislation, Water distribution, Water conveyance, Water costs, *Administrative agencies, Water users, Water demand, Waterworks, *Water rates, *Utilities.

Michigan places the regulation of all private water companies in the control of the public service commission. All extensions or discontinuances of service must be authorized by the commission. The commission must approve all present rates and any future changes in rates. The burden of proof is on the water companies to show that their rates or proposed rates are reasonable. The commission polices the water companies to insure that their service is good and no favoratism is shown to any customers. The commission is authorized to investigate and hold hearings on any complaints received or on its own motion. Any water company dissatisfied with the judgment of the commission may appeal to the circuit court. Upon trial of the action, no new evidence may be introduced until first submitted to the commission for reconsideration of the finding. The burden of proof is on the complainant to show by clear and satisfactory evidence that the order of the commission is unlawful or unreasonable. (R. H. Watson-Fla)
W69-00779

SCOZZAFAVA V US (GOVERNMENT USE OF STREAM BEDS).
199 F Supp 43-46 (D C N Y 1961).

Descriptors: *Ownership of beds, Navigable waters, *River beds, Eminent domain, Water law, Legal aspects, Federal government, Navigation.
Identifiers: Dominant servitude.

The question is whether the owner of the river bed of a navigable stream may demand rent from the United States for the storage of the latter's deactivated vessels in the stream. The court noted that the title of the owner of fast land on the shore of a navigable waterway is subordinate to the public right of navigation and the power of Congress over the improvement of navigable rivers. Lands below the high water mark are subject to a dominant servitude in the interest of navigation. The deciding issue is whether the government's acts are in aid of navigation thereby freeing the government from a duty of compensation. The court held the question to be one of fact and not to be decided on a motion to dismiss. (Horner-Fla)
W69-00876

PRELIMINARY DESIGN AND SIMULATION OF CONVENTIONAL WASTEWATER RENOVATION SYSTEMS USING THE DIGITAL COMPUTER,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
Robert Smith.
Water Pollut Contr Res Ser Publication No WP-20-9, 64 p, March 1968. 34 fig, 2 tab, 71 ref, 1 append.

Descriptors: *Waste water treatment, *Cost analysis, *Digital computers, *Computer programs, *Computer models, Research and development, Design, Sanitary engineering.
Identifiers: *FORTRAN program, Renovation systems.

A digital computer method and a FORTRAN IV Program listing, used to bring together previously separate calculations for cost and performance of the individual processes waste water treatment systems into one computation for an entire system, are presented with a thorough review and discussion of the subject. This program makes it possible with a fair degree of reliability to compute the capital cost, amorization or debt service cost, and operating and maintenance cost of the entire plant or of individual processes or groups of processes, as a function of independent design parameters. The parameters are plant design capacity, influent stream, fraction of suspended solids removed in the primary settler, mixed liquor suspended solids held in the aerater, demand BOD of plant effluent, and detention time for the digester. Results of computations are shown in tables and graphs. The program was slanted toward preliminary design rather than operation simulation, but the difference is not fundamental because only steady state performance is considered. (Knapp-USGS)
W69-00926

THE LEVEL OF DEVELOPMENT OF WATER RESOURCES,
Joe S. Bain, Richard E. Caves, and Julius Margolis.

In Northern California's Water Industry, Resources for the Future, Wash., D. C., 1966, Chap 15, pp 529-554, 8 ref, 3 tab.

Descriptors: Annual rates, Water resource development, *Methodology, *Water use, Marginal costs, Rate of return, Benefit-cost ratio, Pricing, Marginal benefits, Average costs, Water values, Market value, Administrative decisions, Electric power costs, Marginal productivity.
Identifiers: Sacramento Valley, Northern California, Central Valley, *Water usage development, Water facilities development.

An analysis of the performance of the water industry in Northern California is discussed under the three broad headings of (1) level of development, (2) sequence of development, and (3) rationality of development. Two definitions of the level of development include, (1) level of water facilities development, ie., the quantity of non-water resources going to make water available for use, and (2) 'water usage development,' which is defined at length. The rationality of development is appraised through evaluation of present water allocation among users, uses, sites, and time. Measurement of the above factors is considered in situations of water scarcity and plenty. As standards of measurement, marginal values, rates of return, and benefit-cost ratios are considered. Evaluation of local public water agencies is done through deductive inferences and inductive measures of performance. Statistical evidence on the level of development of these local agencies is through analysis of rates of return, and relation of long-run marginal costs to marginal values. In a similar, but brief, manner, the level of development and behavior of large wholesale agencies is also considered. (Gargola-Chicago)
W69-00948

THE INVESTMENT DECISION,
Resources for the Future, Washington, D. C.
Joe S. Bain, Richard E. Caves, and Julius Margolis.

In Northern California's Water Industry, Chap 11, 1966, p 363-79, 1 tab, 19 ref.

Descriptors: *Water supply, Water demand, Discount rate, Decision making, Intangible benefits, *Evaluation, Water rates, Discriminatory pricing, Municipal water supply, Evaluation, Water resource planning, Water users, Water values, Financial feasibility, Financing, Capital investiment, *Investment, Water law, *Institutional constraints.
Identifiers: San Francisco Bay Area, Uncertainity, East Bay Municipal Utility District.

Important environmental forces affecting investment decisions in the San Francisco Bay area are (1) rivalry of agricultural uses, and (2) multiplicity of governments. In light of these factors the internal decision making and investment criteria of urban agencies is considered. Some of the requirements for agency investment are: (1) prompt arrival of supply, (2) capital outlays financed by revenues, (3) adequate supply to meet long-term needs, (4) high quality water, (5) minimization of cost. Evaluation of benefits is rarely considered, due to difficulties in their assessment, so minimization of cost is the only real economic consideration. The discount rate, treatment of uncertainty, and adjustment for future price changes is discussed, and possible sources of error in the use of the factors are considered. Performance uncertainties created by external forces bearing on water investments are demonstrated by examples of urban water agency experiences in the bay area. (Gargola-Chicago)
W69-00951

MUNICIPAL WATER RATES,
Rand Corporation, Santa Monica, California.
Jack Hirshleifer, James C. DeHaven, and Jerome W. Milliman.
Water Supply, Economics, Technology, and Policy, 1960, p 87-112, 4 fig, 2 tab.

Descriptors: Discriminatory pricing, Water allocation, *Municipal water supply, Average costs, Marginal costs, Average prices, *Economic evaluation, Optimum development plans, Economic efficiency, Market value, *Water rates, Water values, Peak load, Joint costs, Economies of scale.
Identifiers: Optimum output, Two-part tariff.

Discussed is the applicability of theoretical principles of pricing to municipal water rates. Explored in relation to this are the alternatives of average cost vs. marginal cost pricing. In either case, whether or not a profit is possible, a loss is incurred at the optimal output if a single price is charged. Several possible ways to overcome the difficulty are given: (1) government subsidy, (2) receiving as revenue voluntary contributions for continuation of service, (3) setting up descending scale of prices, (4) a two-part tariff system, and (5) price discriminations. The problem of adjusting rates to different classes of consumers is considered in discussing joint costs. A detailed discussion of costs as functions of scale of output, and classification of costs is given. The merits of either capacity charge or peak load pricing are reviewed and considerations of the water demand in fire protection is discussed. Under-pricing and over-building in water supply are also considered. In conclusion, the results of previous discussions are drawn together and suggestions made for development of future municipal water rates. (Gargola-Chicago)
W69-00956

INSTITUTIONAL SUGGESTIONS FOR WATER QUALITY MANAGEMENT,
Resources for the Future.
Allen V. Kneese, and Blair T. Bower.
Managing Water Quality: Economic, Technology and Institutions, Baltimore: Johns Hopkins Press, 1968, Chap 14, pp 301-318, 1 tab, 11 ref.

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Descriptors: *Water quality control, Non-structural alternatives, Water resource management, Institutional constraints, Adoption of practices, Regional analysis, State governments, Local governments, *Administrative decisions, Decision making, Federal government, Industrial wastes, Effluents, *Control systems, Optimum development plans.
Identifiers: Effluent charges, External costs.

To provide a firm foundation for efficient progress in water quality management an economic optimization approach is suggested. Agencies should be established with powers to plan and implement management programs for entire regions. Granted these powers agencies should be able to, (1) progress toward systematic methods for reflecting external costs associated with water discharges, (2) define, evaluate, and implement measures to reduce adverse effects of waste discharge, (3) produce more efficient operation of water quality management system, (4) adapt new knowledge and technology, (5) give consideration to impacts of spatial patterns of economic activities on water quality management. With the above factors as stated goals of regional water quality management, there are certain criteria which should be met if agencies are to be effective; i.e. the ability to internalize major externalities, implement relevant measures, take account of significant interrelationships, and provide opportunities for affected parties to have a voice in decisions. The role of the federal, state and local governments in the formulation of this regional is defined, with suggestions for the financing. Systems of direct regulation, charges for waste discharge, and payments to dischargers are discussed as possible means of revenue. The advantages and disadvantages are reviewed, and the system of effluent charges is recommended. (Gargola-Chicago)
W69-00959

A CURIOUS SOLUTION TO THE PROBLEM OF OPTIMAL PRICE REGULATION.
Stanford Univ, California.
James N. Rosse.
Am Econ Rev, Vol 58, No 4, pp 863-870, Sept 1968, 2 ref.

Descriptors: *Pricing, *Public utilities, Demand, Welfare (Economics), Elasticity of demand.
Identifiers: *Decreasing cost industry, Informative advertising, Paretian efficiency.

A special solution to the problem of setting an optimal price for a regulated declining cost utility is developed in this article. It is shown that intermittent average cost price regulation makes it profitable for such a utility to transmit price behavior information to consumers. Looking at the steady state analogue of an equilibrium generated by the introduction of such information, it is shown that average cost price regulation and consumer information are consistent with necessary conditions of Paretian efficiency if and only if all consumers have the same elasticity of demand for the product. Thus, the situation avoids the efficiency-redistribution dilemma of standard optimal price regulation theory. Idealized rate cards are suggested as a means of transmitting necessary information to consumers. (Seneca-Rutgers)
W69-01065

THE ECONOMIST'S ROLE IN WATER PRICING POLICY,
California Univ., Davis.
W. E. Johnston.
Proceedings Water Pricing Policy Conference, Report No 13, University of California Water Resources Center, pp 28-40, March 1968. 5 fig.

Descriptors: *Water requirements, Water resources development, Water demand, Water policy, *Pricing, *Elasticity of demand, Profit, Conservation.
Identifiers: Kern County Water Agency, Rationing.

In reality, use of the optimum economic criterion that marginal cost equal marginal value in use, is not appropriate for a water-supplying agency. To the firm, water is but one of several inputs. However, a public water agency's objective is commonly regarded as that of securing reliable water supplies for its members; profit maximization is not its goal. With investments of such magnitudes, as necessary for water resource development, the average cost curve usually declines throughout the range of system capacities. The appropriateness of using marginal-cost pricing when faced with a declining average cost curve is debatable. Water can be differentiated according to differences in time, place, and quality. This differentiability also makes the pricing problem more difficult. If distribution systems have a limited capacity, users must wait on a rotational system of water delivery, and this may increase the efficiency of their use of water. Variations in tax-toll mixes may provide incentives for allocation of water use to conform to district objectives. (Seneca-Rutgers)
W69-01077

WATER PRICING: A SOCIAL DECISION-MAKING PROCESS,
California Univ., Los Angeles.
Ernest A. Engelbert.
Proceedings Water Pricing Policy Conference, Report No 13, University of California Water Resources Center, pp 59-69, March 1968. 13 ref.

Descriptors: *Pricing, Water rates, Social change, *Social aspects, Water policy, *Decision making, Ethics, Aesthetics, Institutions, Water resources development.
Identifiers: Public objectives, *Behavioral sciences, Due process, *Multiple water pricing systems.

Social non-economic considerations have always permeated water policy decision-making processes. These may be categorized under four broad headings, namely (1) ethical considerations, (2) social policy considerations, (3) considerations involving due process, and finally, (4) aesthetic considerations. In actual practice, these are not so neatly categorized by our various water pricing systems, and indeed, are not easily separated. Under ethical deterents, high priority is placed upon the use and development of water for the sustenance and protection of human life; it is also considered ethically desirable to conserve resources for future generations. Among the more important social policy objectives have been the use of water to facilitate regional and national growth; to influence the spatial distribution of population, and to promote the public's general welfare. Standards of due process are the procedures whereby individual rights are secured and maintained, they consciously establish water institutions and procedures that will minimize social conflict. Aesthetic factors are involved with society's interest in using and conserving water resources to protect the beauty, quality and liability of the natural environment. (Seneca-Rutgers)
W69-01082

INPUT-OUTPUT PROJECTIONS: CONSISTENT PRICES AND QUANTITY STRUCTURES,
Cambridge Univ., Cambridge, England. Dept. of Applied Economics.
Richard Stone.
L'Industria, Vol 102, No 2, pp 212-224, April-June 1968. 6 ref.

Descriptors: *Input-output analysis, *Least squares method, Forecasting, Constraints.
Identifiers: Variance matrix, *Best linear unbiased estimator, *Price vector, *Coefficient matrix, Factors of production.

In order to construct a coherent system for the projection year, it is necessary to introduce the prices of that year as well as the quantities. If we form initial estimates of factor and product prices the resulting system is not likely to be coherent because the initial estimates of prices are not consistent with the initial estimates of the quantity structure. This paper shows how the well known method of adjusting conditioned observations in the method of least squares can be applied to the problem of making consistent input-output projections. There are three possible means of adjustment: (a) accept initial estimates of intermediate and primary coefficient matrices and adjust only product and factor prices; (b) accept initial estimates of these prices and allow the adjustment to fall on the intermediate and primary coefficients (c) adopt some compromise between these extremes. A numerical example is provided for all three cases. This method is simple and the difficulties associated with it are mainly practical. It can only be tested through applications. (Seneca-Rutgers)
W69-01105

6D. Water Demand

ARKANSAS WATER RESOURCES: SUPPLY, USE, AND RESEARCH NEEDS,
Arkansas Univ., Fayetteville.
Jared Sparks.
Water Resour Res Center Publ 2, 1967. 100 p, 15 fig, 10 tab, 25 ref. OWRR Project A-006-Ark.

Descriptors: *Research and development, Multiple purpose reservoirs, *Water supplies, Chemicals, Sediments, *Water pollution, Floods, *Water management (Applied), *Surface waters, *Groundwater, *Hydrologic data, *Water utilization, Water balance, *Economics, Groundwater recharge, Limnology.

The purpose of this study is to identify Arkansas water resources research needs based on economic backdrop of water supply and use conditions. Arkansas has an abundance of high quality water for present use. There are local conditions causing water problems, but, critical water problems in Arkansas are emergent and potential rather than actual. Causes of these problems are to be found mainly in the economic, legal, and social institutions surrounding water use--and particularly in the economic institutions. Research designed to improve economic efficiency criteria and to develop methods of applying such criteria to water resources planning, to water resources allocation and to quality of water control would do much to mitigate water management problems in the future. Research of this nature requires more water data concerning supply, use, and costs associated with water use than are now available. Other promising areas of research include research on the nature of water and water cycle, applied research in areas of flood control, artificial recharge, measurement of pollution damage and costs, identification and treatment of pollution, limnology of artificial lakes and the role of water resources in industry location.
W69-00706

LISTS OF REFERENCES AND SELECTED BOOKS BEARING ON WATER RESOURCES IN MINNESOTA,
Minnesota Univ., Minneapolis.
William C. Walton.
Water Resour Res Center Bull 4, Dec 1966. 36 p, 711 ref. OWRR Project A-999-Minn.

Descriptors: *Water resources, *Reviews, *Bibliographies, Biology, Climatology, Forestry, Geology, Groundwater, *Lakes, Streams, Water pollution, Hydrology, Water supplies, Streamflow, Sociology, *Minnesota.

This bulletin lists 711 references on water resources in Minnesota including: Biological Aspects, Climatic, Forests and Water, General Geology and Groundwater, Lakes, Land and Water, Legal Aspects, Streamflow and Floods, Water-based Recreation, Water Pollution, Water Resources, and Wetlands. Selected books bearing on the physical, biological and social aspects of water resources in Minnesota on the following subjects are also listed: Climate, Conservation,

Recreation and Wildlife, Fluid Mechanics, Groundwater, Hydrology, Lakes and Biological Aspects, Mathematical and Computer Aspects, Social-Economic Aspects, Soils-Plants-Water, Streamflow, and Water Supply and Waste Disposal.
W69-00731

EVALUATION OF WATER RESEARCH NEEDS IN ALASKA,
Alaska Univ., College.
Charles E. Behlke.
Inst Water Resour Rept, 1968. 9 p. OWRR Project A-006-Alas.

Descriptors: Water resources, *Water resources development, Climatic zones, Population, Cold regions, Permafrost, Water management, *Alaska, Evaluation, Planning, Arctic, Oil fields.

The water resource research requirements for Alaska reflect the needs of a rapidly expanding population and industrial growth in an unpopulated country. It appears that many problems which have been researched elsewhere must be restudied in Alaska because of climatic extremes. Most of the southern coastal areas of the State exhibit from 70 to 350 in. of runoff/yr and in much of the northern part of the State permafrost to great depths and seasonal frost lock virtually all water in a solid state for a major part of the year. Alaska is proving to be an area with vast petroleum reserves. These reserves are being brought into production and are resulting in development of previously unpopulated areas. The proper management of previously untouched waters requires knowledge of the nature of the existing resources and then an evaluation of the probable effects of alternative water uses in order to optimize the desirable use of Alaskan water resources. This evaluation of present conditions and analysis of future possible uses require vast amounts of research.
W69-00743

AN ACT CONCERNING USE OF WATER FROM RIVERS FOR PUBLIC CONSUMPTION.
Connecticut Public Act No 792 (1967).

Descriptors: *Water utilization, *Water permits, Administrative agencies, *Connecticut, Legislation, Water allocation (Policy), Water users, Public utilities, Public rights, Water distribution (Applied), Utilities, Water law, Legal aspects, Municipal water, Navigation, Reasonable use.

Any public water supplier is given permission to take water from any river if it applies to and receives a permit from the Water Resources Commission. The application must be consented to by a public service company if the company's rights are affected, or the Public Utilities Commission must approve the diversion. The Water Resources Commission makes an investigation, holds a public hearing, cooperates with other state agencies, and makes a determination with respect to the application. The permit may be revoked or modified by the commission if it is in the public interest to do so. Any person aggrieved by the commission's determination may appeal to the superior court. (Horner-Fla)
W69-00769

LITTLE WABASH RIVER BASIN STUDY, A COMPREHENSIVE PLAN FOR WATER RESOURCE DEVELOPMENT,
Illinois Department of Public Works and Buildings, Springfield Division of Waterways.
Bruce Barker, John B. Carlisle, and Raymond Nyberg.
Rep, State of Illinois, Springfield, Ill., 1967, 76 p, 29 fig, 21 tab, 36 ref.

Descriptors: Hydrology, Drainage, Irrigation, Research and development, Project planning, Financing, Administrative decisions, Soil classifications, Streamflow forecasting, Water sources, Control river basin planning, Water quality, Pollution abatement, Waste water discharge, Biological oxygen demand, Flood damage control, Federal reservoirs, Irrigation, Drainage program.
Identifiers: Well yield, Little Wabash River Basin, Louisville reservoir, Helm Reservoir, Illinois.

To provide a background for development, significant aspects of physical geography, basin economy, hydrology, and water supply are evaluated. Utilizing this information, research and recommendations are made in problem areas of water quality control, flood damage control, agricultural drainage and irrigation. Pollution problems in the basin are the result of inferior waste water treatment, high BOD loading of streams, and oil field pollution. The control of these will be mainly achieved through improved municipal waste water treatment facilities. It is recommended that flood damage control be implemented to the maximum extent consistent with economic efficiency. Measures given which satisfy these criteria are: (1) the control of urban encroachment; (2) reclamation of bottomlands; and (3) flood control reservoirs. Three proposed levee districts are recommended as the best means of achieving reclamation in the bottomlands for agricultural purposes. Since basin agriculture is becoming more important relative to total state agriculture, if it can be shown that irrigation is a good investment, these proposals should be implemented. The continued validity of the above recommendations is dependent on whether the basic data and derived relationships put forth truly represent present and anticipated future needs. If the above recommendations are implemented, the projected economic growth of the Little Wabash River Basin will not be limited. (Gargola-Chicago)
W69-00945

STATUS OF WATER RESOURCES USE, CONTROL, AND PLANNING IN THE UNITED STATES,
National Academy of Sciences-National Research Council, Washington, D. C.
Abel Wolman.
Journal of the American Water Works, Vol. 55, No. 1, 1963, p 1253-1272, 1 fig, 2 tab.

Descriptors: Water resources development, *Evaluation, Optimum development plans, Water supply, Water demand, Social aspects, Water allocation, *Decision making, *Project planning, Education, *Research and development, Water pollution, Hydrologic cycle, Scientific personnel.
Identifiers: International implications.

Identified are the more significant problems in the water resource field, and in areas of physical science research that will contribute to more effective use of water resources. First, the general aspects of the behavior of water in the hydrosphere are reviewed and some general problems that arise from the physical characteristics of water supply and the nature of man's demand for it. The availability of water resources in the United States today is discussed and evaluated with respect to the demands for their use. Some general problems of water resources development and allocation in arid, semi-arid, and humid areas, are discussed as to both their physical and social aspects. Unique considerations that govern the administration and use of water, such as economics and the laws related to water use are reviewed, and suggestions for their improvement made. In regard to the physical science aspects of water research specific problems are discussed and research proposals made in order of priority. Forecasting and control of channel modifications, approximation of optimum water resources systems, streamflow forecasting, weather forecasting, and study of physiologic aspects of water quality, are the research needs which have the greatest benefit for all areas. (Gargola-Chicago)
W69-00952

NEW LOOK AT RESOURCES POLICY,
Cornell Univ., Ithica, New York, Eng Dept.
Gordon P. Fisher.
Journal of American Water Works, Vol. 57, No. 3, March 1965, p 255-61, 2 ref.

Descriptors: Water supply, Water demand, *Water resources management, *Project planning, *Investment, Water reuse, Pollution abatement, Market value, Water laws, Riparian rights.
Identifiers: Public policy.

The water problem in the United States is not that of a widespread water shortage, but rather a water management problem. Five major factors contribute to this: (1) increasing demand for water, (2) conflicting demands for water resources, (3) concentration of demand in certain areas, (4) lack of regional management and coordination, and (5) lack of efficient organization for planning. Possible solutions to these problems are considered in areas of water costs, pollution, water laws, and reuse. In conclusion, suggestions for formulation of public policies which call for vast cooperative effort between engineers, economists, and lawyers are put forth. (Gargola-Chicago)
W69-00953

ECONOMIC CONSIDERATIONS FOR THE DESIGN OF WATER INSTITUTIONS,
Indiana Univ., Bloomington.
Jerome W. Milliman.
Public Administration Review, March, 1965, pp 284-289, 6 ref.

Descriptors: *Water resource management, Water law, *Water allocation, Marketing, Marginal product, Marginal costs, Pricing, *Economic evaluation, *Decision making, Regional analysis, Institutional constraints, Water transfer, Rates of return, Water supply, Marginal costs.
Identifiers: Marginal value, Modification of laws.

The problem of water resources appears to be not one of inadequate supply, but rather of rational allocation among competing uses. The solution lies in sensible management of resources, and in the application of economic principles in allocating existing supplies and in development of new supplies. A system of regional water management could deal more effectively with water problems than existing management methods. The fact that there are no uniform water laws results in a failure to deal with obvious externalities, and prevents development of an efficient market system. Suggestions for modifying present laws and defining the function of public agencies in the law are given. Two major economic principles: (1) equalizing marginal values in uses, and (2) marginal cost pricing are significant in water resource allocation. Ignoring the effects of these principles in water resource investments can lead to inefficient allocation of existing water supplies. Increased efficiency of water resource development lies in a merger of unapproved institutional and economic decision making frameworks. (Gargola-Chicago)
W69-00954

TRENDS IN WATER USE,
Partner, Pate, Hirn, and Bogue, Detroit, Michigan.
Stuart H. Bogue.
Journal of American Water Works, Vol. 55, No. 5, May 1963. p 548-54, 5 fig, 2 tab.

Descriptors: *Water use, Water rates, *Industrial use, Municipal water supply, Peak load, Water supply, *Water consumption, *Water requirements, Water distribution.
Identifiers: New York (New York), St. Louis, Pittsburgh, Washington, D. C.

Enumerated are ten factors which affect water use. Large increase in per capita consumption of water is a result of new fixtures and appliances which use greater quantities of water. Variations in demand of industrial and residential rates are discussed; from data gathered it is shown that industrial use of water tends to minimize large fluctuations in demand, while residential use does not. Relations are drawn between such factors as home value, income

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and water use. In conclusion, it emerges that there has been no appreciable depletion of water supplies. In fact there is no need to worry about the availability of water supplies if the citizens are willing to pay for them. (Gargola-Chicago)
W69-00957

RESEARCH IN GROUND WATER ECONOMICS IN THE HIGH PLAINS AREA OF COLORADO,
Colorado State Univ., Fort Collins, Econ Dept.
Paul W. Barkley.
Pap, 18th Annu Expo Natl Water Well Assoc, Columbus, Ohio, Oct 5, 1966. 10 p. OWRR Project B-007-Colo.

Descriptors: *Ground water, *Colorado, Aquifers, Economics, Water users, Irrigation, Water Development, Wells, Irrigation wells, Water wells, Groundwater mining, Pumping, *Groundwater recharge.
Identifiers: *High Plains, USA, Eastern Colorado.

This report covers ground-water resources in a crescent shaped area along the eastern border of Colorado. In 1960 this area contained an estimated 80 million acre-ft in ground-water storage with 30 million acre-ft economically recoverable. The area includes 9000 sq mi that for decades had been a dry farming area. In 1960 fewer than 400 wells yielded 60,000 acre-ft for irrigation and an additional 10,000 acre-ft was supplied by wells for other purposes. From 1961 to 1964 an average of 200 wells per year were brought into production for irrigation. In 1965, annual yields from the aquifer were slightly in excess of the estimated natural recharge of 430,000 acre-ft. This area now is confronted with the problem of declining water tables. As farm operators switch to irrigate agriculture, nonfarm economy expands. These expansions must lead to some type of control. Insufficient information exists on dollar volume of on-farm and off-farm effects to be of service to legislatures. Ground-water development must proceed through combined efforts of irrigators, business groups serving irrigators and researchers.
W69-00986

AN ECONOMIC ANALYSIS OF WISCONSIN'S DIVERSION PERMIT SYSTEM FOR AGRICULTURAL IRRIGATION,
Wisconsin Univ., Madison, Agri Econ Dept.
Frank H. Osterhoudt.
Water Resour Res, Final Rep, 1967. 427 p, 17 fig, 75 tab, 33 ref, 3 append. OWRR Project A-008-Wis.

Descriptors: Water laws, *Water rights, Adoption of practices, Riparian land, *Riparian rights, Irrigation, Irrigation practices, *Permits, Irrigation wells, *Irrigation permits, Wisconsin, Bibliographies.

This study was conducted to learn the parts of the diversion permit system that would affect the economic decisions of current irrigators. This was done through the study of files of the Land and Water Use Section, Dept of Natural Resources, an area study of all irrigation of E Barron County and mapping of riparian status of about 50 mi of lakes and streams. In Wisconsin, riparian land is considered to include all government lots, quarter-quarter sections, and tracts of land actually owned when less than these legal subdivisions which are actually in contact with water. In addition, such other tracts adjacent to such above-named tracts also are riparian if owned by the same person and if they have come to present ownership in an uninterrupted chain of title from the original government patent. This is known as source of title test. Among the specifications of individual permits, it was found that allocation of water for irrigation by the source of title test was the major element to affect irrigators and appeared to be particularly unsatisfactory. Perhaps this study will provide a basis of data and ideas to develop an understanding and eventually an equitable allocation of Wisconsin's water supply.
W69-01000

EFFECT OF IRRIGATION METHOD ON WATER CONSERVATION,
Utah State Univ., Logan.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-01021

WATER USES IN THE NORTH PLATTE RIVER BASIN OF WYOMING.
Wyoming Univ, Laramie, Wyoming, Agricultural Experiment Station.
Richard T. Clark.
Research Journal 21, Agr. Exp. Stat., Univ. of Wyoming, Jan. 1967. 62 p, 1 map, 37 tab, 62 ref, 1 append.

Descriptors: *North Platte River Basin (Wyoming), *Irrigation, *Recreation, *Municipal water, *Industrial water, *Waste disposal, Demand.
Identifiers: Economics, *Water utilization.

The present uses and needs of water are described so that future uses, needs, and demand for water may be estimated. Also, the information provided in the report may be used as a basis for future projects. The paper provides a physical and economic description of the area. The uses of water for irrigation purposes, recreation, municipal, industrial, agricultural, and waste disposal are described. This discussion also describes legislation, projects, inventories, and developmental projects that pertain to the various uses of water. The potential demands for water in the areas of irrigation, recreation, residential, and industrial are estimated. After studying use of water in the North Platte River Basin, some conclusions can be reached: (1) Most tributary streams from Casper to the state line including the Laramie River are generally short of irrigation water. Some are even short in above average years. (2) Lands on North Platte tributaries in the upper reaches such as in and around Laramie lack late season water. (3) Lands along the Platte itself, especially below Casper, are not short of water in most years. (4) Most municipalities have adequate supplies for current demands but some have definite problems even in average water years. (5) There exists a demand for more water for recreational purposes. (6) Industries generally have been able to obtain enough water for their purposes. (7) More lands could be irrigated if the water were available. Under present water conditions, however, there is no extra water for irrigation in the North Platte drainage. (8) Pollution does not present a health hazard in the North Platte Basin, but in some areas it is detrimental to fishing. (Grossman-Rutgers)
W69-01062

STORAGE REQUIREMENTS FOR WATER IN THE UNITED STATES,
Resources for the Future, Washington, D. C. and U. S. Geological Survey, Washington, D. C.
George O. G. Lof, and Clayton H. Hardison.
Water Resources Research, Vol 2, No 3, pp 323-354, Third Quarter 1966. 6 fig, 11 tab, 9 ref, 1 disc.

Descriptors: *Water storage, *Costs, Evaporation, United States, Estimated costs, *Storage capacity, Discharge, Probability, Average costs, Marginal costs, Flows.
Identifiers: *Storage requirements, Carry-over storage, Seasonal storage, Water resource regions, Senate Committee Print 32, Net flow.

Storage requirements for various levels of streamflow regulation in the 22 major regions of the contiguous United States are presented and supersede those given in Committee Print 32 of the Select Committee on National Water Resources, U S Senate. At high levels of development, the storage required to provide the desired flow in 95 and 98 percent of the years is substantially larger than that previously given. Carry-over storage requirements based on probability routing of annual discharge are combined with seasonal storage requirements to give the revised storage requirements, which are then used to compute revised evaporation losses and revised cost estimates. The maximum net flow that could be made available for the 22 regions for 98 percent of the years is shown to be 965 billion gallons per day (bgd) for which a storage capacity of 3.6 billion acre-feet would be required. A net flow of 922 bgd could be made available with 2 billion acre-feet of storage. An increment of flow above the 922 bgd could be made available with 2 billion acre-feet of storage. An increment of flow above the 922 bgd figure would have storage costs exceeding ten cents per thousand gallons delivered. (Seneca-Rutgers)
W69-01073

ASPECTS OF SURFACE WATER RESOURCES - HUMBOLDT RIVER BASIN, NEVADA.
Nevada Univ, Reno.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-01111

THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN.
Wyoming Univ, Laramie.
Paul A. Rechard, and Frederick R. Potter.
Prog Rep, Water Resour Res Inst, June 1966. 41 p, 10 fig, 5 tab, 25 ref. OWRR Project A-999-WYO.

Descriptors: Irrigation, Municipal water, *Return flow, *Streamflow, *Water rights, Water utilization, Water measurement, Consumptive use, Hydrologic budget, Hydrologic equation, *Land use, Municipal wastes, Water consumption, Water resources development, *Prior appropriation, Treatment facilities, Wyoming.
Identifiers: Laramie (Wyo.).

Urban growth in the West results in changing the patterns of streamflow in 1 or a combination of 3 ways, these are: (1) variation in consumptive use as particular areas change from irrigated agricultural land to municipalities; (2) peculiar hydrologic characteristics of urban areas that result from 'roofing over' the natural drainage basin; and (3) the effects on streamflow regimen of converting an irrigated area to dry land with concurrent transportation of the water to a municipality located many miles from the original point of use. The study of this latter effect is reported in this paper. Consumption of water by the City of Laramie and by an area north of the city irrigated from the Oasis Ditch was determined on a daily basis from May 1 until September 30, 1965. The regimen of the Laramie River was evaluated by measuring daily flows at 4 different locations during the same period. Tabular results are presented and discussed. Recommendations for further study are included.
W69-01130

LAKE-ORIENTED SUBDIVISIONS IN NORTH CAROLINA: DECISION FACTORS AND POLICY IMPLICATIONS FOR URBAN GROWTH PATTERNS. PART I - DEVELOPER DECISIONS,
North Carolina Univ, Chapel Hill.
Raymond J. Burby, III.
Water Resour Res Inst Rep 9, Nov 1967. 177 p, 6 fig, 18 tab, 53 ref, 4 appen. OWRR Project A-023-NC.

Descriptors: *Land development, *Community development, *Land use, Water quality control, *Environmental engineering, *Lake shores, Water zoning, Decision making, Aesthetics, Developed waters, Public health, Recreation facilities, Safety, *Lakes, Urbanization, Water policy, Watershed management, *Water properties, Water resources development.

This study examines the decisional variables which are important to developer-builders in selecting tracts of land for lake-oriented subdivisions. Public policies affecting development of these subdivisions are examined, and problems following development are considered in terms of the public interest with respect to watershed use, public safety, water quality, ownership and liability, and

ocal-state-federal regulations. The report is based on structured interviews with developers and public officials carried out during the summer of 1967. Included in the survey were 41 lake-oriented subdivisions paired with 41 nonlake-oriented subdivisions in 22 urban areas of North Carolina. An extensive series of hypotheses were tested and are reported in detail. One important finding is that the ability of developers to trade off positive values of site characteristics for environmental innovations, in order to achieve an optimum profit position, provides them with considerably more flexibility in their location decisions than has been previously thought to be the case. As the first step toward adequate control of lake-oriented subdivisions, recommendation is made that subdivision ordinances include provisions governing the use of lakes and other bodies of water in residential subdivisions.
W69-01155

6E. Water Law and Institutions

NEW HORIZONS IN WATER RESOURCES ADMINISTRATION,
Resources for the Future.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00705

THE LAW OF WATER POLLUTION CONTROL,
Mississippi State Univ., State College.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00733

MUNICIPAL WATER RIGHTS,
Edward F. Taylor.
AWWA J, Vol 58, No 7, pp 856-866, Jul 1966. 11 p, 49 ref.

Descriptors: Legislation, *Municipal water, Cities, Federal-State water rights conflicts, *Local governments, Judicial decisions, Water rates, Public utilities districts, Water works, Water contracts.
Identifiers: *Municipal water rights.

The lack of a clear definition of federal and local rights in water has been of deep concern to the National Institute of Municipal Law Officers. The author recommends Congressional Bill S 1275, 88th Congress, 1st Session, which requires the U S to conform to the same rules that bind other public or private claimants. When the Federal Government undertakes to appropriate water rights under state law rather than on the basis of eminent domain of navigational servitude, it must conform to the state requirements. The author cites several cases supporting the general rule that a municipality may exercise reasonable discretion in determining whether to extend its water services. Cases construing the obligations of a municipality once it extends its services to outside connections are also noted. Water contracts should be carefully drafted to prevent a construction of ambiguous terms against the drafter. Generally, there must be a clear showing that the rates set by municipal officers are unreasonable and arbitrary before they can be overruled. A municipal water authority may vary the rates among users in different classifications of consumption. But rates cannot be discriminatory within a class of users. Public Utility Commission authority over municipalities is discussed briefly. Reintroduced in 90th Congress as S 2530. (Molica-Fla)
W69-00745

QUIGLEY V VILLAGE OF HIBBING (RES IPSA LOQUITUR APPLIED IN CITY WATER LINE BREAKAGE).

129 N W 2d 765-772 (Minn 1964).

Descriptors: *Municipal water, *Pipelines, *Pipes, *Minnesota, Water law, Judicial decisions, Local governments, Legal aspects.
Identifiers: *Res ipsa loquitur.

This case involved damage sustained to plaintiffs' subbasement as a result of a break in a water service line, which extended from the main city line through a wall of the plaintiffs' building. The central issue in the case was whether the doctrine of res ipsa loquitur applied in a situation where water supplied commercially by a municipal corporation escaped from a line placed in a public street to carry water from a main to the premises of the user, where, after being metered, it is available for the use of the consumer. The trial court refused to apply the doctrine; but on appeal, the decision was reversed by the Supreme Court of Minnesota. After stating the criteria for application of the doctrine of res ipsa loquitur, the court recognized a division in the authority for utilizing the doctrine in a case like that before the court. However, the court concluded that upon the record the prerequisites for an application of res ipsa loquitur appeared as a matter of law. (Patterson-Fla)
W69-00746

H A BOSWORTH AND SON INC V TAMIOLA (DRAINAGE).

24 Conn Sup 328; 190, A 2d 506-511 (1963).

Descriptors: Eminent domain, Legal aspects, *Legislation, *Drainage, Land reclamation, Drainage effects, Surface drainage, Land development, Land use, Public benefits, Compensation, Damages, Condemnation, Judicial decisions, Water law.

The plaintiff filed a complaint seeking authorization pursuant to section 52-456 of the Connecticut General Statutes to drain land owned and being developed by it by any suitable means over or under and across the rear portion of the defendant's land. The plaintiff alleges that it has been unable to agree on the mode of drainage and the damages to which the defendants would be entitled and thus applies for power to drain its land across the defendant's land pursuant to the aforesaid statute. The defendant filed a demurrer attacking the complaint as one which contemplates a taking of property in violation of due process. The demurrer further asserts that sections 52-456 to 52-460, are unconstitutional. The court examines the history of the Drainage Act and concludes that it may be constitutional if used for the public good, but could be unconstitutional if the drainage is primarily for the benefit of the plaintiff. The court dismissed the defendant's demurrer stating the constitutionality of the Drainage Act could not be satisfactorily determined on the demurrer. (R. Smith-Fla)
W69-00747

GAMER V TOWN OF MILTON (PERCOLATING WATER).
195 N E 2d 65-67 (Mass 1963).

Descriptors: *Percolating water, Subsurface waters, Subsurface drainage, Recharge wells, Pumping, Soil analysis, Soil compaction, Drainage, *Groundwater, Ponds, Excavation, Recharge.

The defendant is the owner of a parcel of property known as the Turner's Pond area. The plaintiffs are the owners of residences which are adjacent to this area. The defendant entered into a contract with a contractor to excavate and remove gravel from the Turner's Pond area. In order to excavate and remove the gravel the contractor removed the water from the area by pumping it from the pond into a stream, where it flowed away. As a result of this operation water was withdrawn from the upper levels of the sub-soil causing settlement under plaintiffs' houses. This result was foreseeable to defendant. The court found the issue to be whether the contractor's procedures were negligent. The court held that there was such negligence since the contractor had not taken proper precautions to protect the plaintiffs' adjacent land. The contractor could have dug observation holes, sheathed its excavations, and used recharge wells. (R. Smith-Fla)
W69-00748

STATE V COCKRELL (OWNERSHIP OF BEDS AND ALLUVION).
162 So 2d 361-384 (La 1964).

Descriptors: *Louisiana, *Ownership of beds, *Accretion (Legal aspects), *Water law, Judicial decisions, Navigable waters, Streams, Lakes, Watercourses (Legal), Boundary disputes, *Boundaries (Property), Riparian rights, Water policy, Legislation.

The case involves an action of trespass brought by the State of Louisiana et al against defendants Cockrell et al, who drilled a gas well on property plaintiffs claimed to be the bed of Six Mile Lake. Plaintiffs' theory was that defendants' well was on the bottom of a lake navigable at the time of admission into the Union, and therefore the lakebottom was owned by the state by virtue of its inherent sovereignty. Defendants claimed the well was drilled on alluvion in front of defendants Zenors' property. In essence, defendants claimed that the lake was a 'river or stream' within the meaning of the term as used in LSA-CC Article 509, which provides that owners of lands adjoining rivers or streams are entitled to accretions which imperceptibly form alluvion attached to the shore. After careful examination of relevant cases and facts in issue, the court held for the defendants, stating, inter alia, that Six Mile Lake was an 'other stream' under LSA-CC Article 509 and therefore, unlike the case with true lakes having no currents, alluvion belongs to the riparian owner and not the state. (Patterson-Fla)
W69-00749

CULBERTSON V GROSS (SURFACE RUNOFF).
77 York 50-55 (Pa Com Pl 1963).

Descriptors: Surface runoff, Surface water, Drainage, Flooding, Drainage water, Rain water, Soil erosion, *Surface drainage, Slopes, Pipes, Artificial watercourses, Flow, Land development.

This is a dispute between adjoining land owners over the drainage of surface water. Plaintiffs by their complaint seek an injunction restraining defendant from obstructing the water flow from their land to his, and also request damages for injury to their land as a result of the consequent flooding. Defendant denied plaintiff's right to have the water flow as stated and counter claimed for an injunction restraining plaintiffs from discharging the water on to his land. The court applied the rule that one may not be artificial means gather water into a body and precipitate it upon his neighbor's property. The court concluded that both parties will have received equitable treatment if the plaintiffs reduce length of their drainage pipe and defendants accept the resulting more natural flow for absorption by his land and conveyance of any excess through his drainage ditch. Plaintiff was awarded no damages since the court found no permanent injury or reduction in the value of the land as a result of the flooding. (R. Smith-Fla)
W69-00750

BOETTCHER V STROCK (ALTERATION OF FLOW).
77 York 86-89 (Pa Com Pl 1963).

Descriptors: Boundaries (Property), Streams, *Streamflow, Floods, Running waters, Bank erosion, *Retaining walls, Stream erosion, Natural flow, *Alteration of flow, Storm runoff, Boundary disputes, Legal aspects.

The properties of the parties are adjacent to each other. In 1954, the immediate predecessor in title to the defendants erected a wall on a portion of the

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South side of the stream which forms a common boundary between the two properties. This wall changed the bank of said stream so that it was vertical instead of sloping. The defendants, after the flood of 1960, rebuilt the wall on the same concrete footer that had originally been built by Whiteacre. The position of the plaintiffs is that the defendants have, by the maintenance of the wall, produced two results, (1) increased the amount of water flowing over plaintiff's land and (2) caused the stream to change its course so as to encroach on plaintiff's land. The court in dismissing the plaintiff's complaint held that although equity has jurisdiction to grant a remedy for continuing trespass that would result from interference with the flow of the creek or flooding, no such violation had been proven as a result of the defendants conduct. (R. Smith-Fla)
W69-00751

TREADWELL V WALDEIER (COMMON LAW RULE OF SURFACE DRAINAGE).
34 Misc 2d 339, 228 N Y S 2d 390-394 (1962).

Descriptors: *New York, *Surface runoff, *Repulsion (Legal aspects), *Water rights, Water law, Judicial decisions, Surface drainage, Drainage water.

Plaintiff brought this action for an injunction to restrain defendants, sued individually and as the Board of Education of Union Free School District of the Village of Ardsley, from diverting surface drainage waters from defendant's school property into a pond to the north of plaintiff's land in which plaintiff had certain easement rights. The court distinguished the common law rule of surface drainage from the civil law rule. Under the common law rule, which is the law in New York, neither upper or lower owners hold a dominant or servient estate with respect to each other. Both have equal rights to improve their property come what may to the surface water, provided the improvements are made in good faith to fit the property for some rational use and the water is not drained into the other's property by artificial means. Although artificial means were used here, the court refused to grant the injunction because the plaintiff failed to prove an increase in the flow of water as a result of defendant's actions. (Patterson-Fla)
W69-00752

NORMANOCH ASS'N INC V DEISER (OWNERSHIP OF BEDS).
40 N J 100 190 A 2d 845-852 (1963).

Descriptors: Lakes, Lake beds, *Lake shores, Boundaries (Property), Boundary disputes, Legal aspects, *Ownership of beds, Water law, Dredging, Surveys, Mapping.

The issue which confronted the court was the question of title to the subaqueous lands in that portion of Culvers Lake adjacent to the high land undisputably owned by defendant. The court ruled that this was similar to an action of ejectment and thus the plaintiff must prove that he is the owner of the lands involved. The chain of title of both parties was examined in great detail and the court concluded the solution to the problem was in the location of the lake shore in 1905. The first accurately surveyed location of the shoreline of the water bordering defendant's lot is that furnished by plaintiff in 1959. The defendant's deed, however, contains a call for a natural monument which creates a presumption that the line as delineated by the first survey has existed in such conformation and has continued unchanged from the date of the original deed. The court held title to the bed of Culver Lake was in plaintiff and enjoined the defendant from using the waters for a dock or other sundry purposes. (R. Smith-Fla)
W69-00753

MANUAL ON PROBLEMS OF ACCRETION,
Frank I. Towle.
Manual on Problems of Accretion, pp 1-101, (second printing) 1959. 102 p, 5 fig, 3 map, 6 photo, 4 dwg, 7 chart.

Descriptors: *Accretion (Legal aspects), Surveys, Meanders, *Boundaries (Property), Legislation, Ownership of beds, Aerial photographs, Photography, Hydrograph, Flow measurement, Riparian rights, Islands, Beds, Navigable waters, Bank erosion, Shores, Avulsion, Hydrograph analysis.
Identifiers: Flow duration curve, Isopleth.

Appraisers, title examiners, attorneys, and engineers should find this manual useful in the evaluation of the merits of claims which involve the ownership of land formed by accretion and the examination of titles to properties abutting rivers, streams and other bodies of water. The manual includes an outline of suggested procedures for determining the historical boundaries of riparian property, and a list of the federal, state and county agencies from whom pertinent material may be obtained. It is amply illustrated and includes sketches of some of the more common methods used by the courts for the apportioning of alluvion. The manual also explains the value of aerial and ground photographs, and the application of nomographs, hydrographs and flow-duration curves to the problem of land accretion. (R. Smith-Fla)
W69-00754

FEDERAL PROJECTS FOR IRRIGATION AND WATER SUPPLIES.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-00757

TENNESSEE VALLEY AUTHORITY.

16 USCA Secs 831-831h-1.

Descriptors: *Tennessee Valley Authority Project, *Tennessee River, Mississippi River Basin, *Flood control, Channel improvement, *Navigation, Eminent domain, Dams, Reservoirs, Project planning, Federal government, Relocation, Legislation.

The Federal Government, for the primary purposes of controlling the destructive flood waters in the Tennessee and Mississippi River Basins and the improvement of navigation in the Tennessee River, created the Tennessee Valley Authority (TVA). TVA was vested by statute with enumerated powers to carry out its objectives. The right of eminent domain, exercised in the name of the United States, and the acquisition of real estate by purchase or condemnation, with title being taken in the name of the United States, are among those enumerated powers. Real estate thus acquired would be used for the construction of dams, reservoirs, navigation projects and other structures along the Tennessee River and its tributaries for the promotion of navigation and control of flood waters in the Tennessee and Mississippi River drainage basins. Where such construction would flood or destroy lands, easements, or rights-of-way belonging to private persons, corporations, or local governmental agencies, TVA is authorized to convey replacement land by warranty deed. Also, if such construction impairs or damages any bridge, highway or railroad structure over, across or upon the Tennessee River or its tributaries, the corporation shall compensate the owners of such structures for the cost of reconstruction, relocation or replacement. The corporation is directed, in the operation of any dam or reservoir in its possession, to regulate stream flow primarily for the promotion of navigation and control of floods. (Geraghty-Fla)
W69-00758

TENNESSEE VALLEY AUTHORITY.
16 USCA Secs 831h-2 to 831dd.

Descriptors: *Tennessee Valley Authority Project, Tennessee River, *Electric power, *Transmission (Electrical), Dams, Financing, *Water resources development, River basin development, Conservation, Condemnation, Transmission lines, Legislation.
Identifiers: Clinch River.

TVA, in order to avoid the waste of water power, is authorized to provide and operate facilities for the generation, transmission and marketing of electricity. Surplus electric power, not needed by TVA for the operation of locks or other structures, is to be sold to states, local governments, private individuals and corporations. There are numerous provisions regarding such sales, including provisions for the purchase or lease of transmission lines by TVA. Financing of construction projects is provided for through the use of bonds. Specific authorization is granted for the construction of Cove Creek Dam across the Clinch River, including the right of eminent domain and condemnation to acquire the necessary property. To aid in the conservation and development of the natural resources of the Tennessee River drainage basin and adjoining territory, surveys and general plans for orderly and proper physical, economic and social development of that area and to be promulgated. Construction of dams, appurtenant works or other structures affecting navigation on the Tennessee River System are prohibited unless plans for such construction are first approved by TVA. Notes and annotations are included and the publication is updated by pocket part supplements. (Geraghty-Fla)
W69-00759

DESIRABLE FEATURES OF WATER RIGHTS LAWS,
Nebraska Dept of Water Resources, Lincoln, Nebr
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00760

SUPPLEMENTARY HISTORY OF TITLE OF MASSACHUSETTS TO SUBMERGED SEA LANDS,
Richard Wait.
Mass L Q, Vol 36, No 1, pp 17-26, May 1951. 10 p

Descriptors: *Massachusetts, *Ownership of beds, Political aspects, *Water law, Judicial decisions, *Boundary disputes, Federal-state water right conflicts.
Identifiers: *Ownership of seabeds, Constitutional law.

The purpose of the article is to clarify what the author believes to be a mistake of law made by the U S Supreme Court in the California case, 332 U 19. In that case, the court rejected as unsound the first premise of California's argument that the original thirteen states owned submerged lands of their shores at least to the 3 mile limit, and hence California should have similar property under the 'equal footing' clause of the Constitution. The author accuses the court of rejecting the good title of the original thirteen states to their submerged lands without discussing its muniments. He then sets forth and analyzes the documentary evidence of Massachusetts' title to her submerged lands tracing the title back as far as 1629 and continuing the chain through the present. The author also takes issue with the position of the court that prior to the 19th Century the law recognized no property in submerged offshore lands. (Patterson-Fla)
W69-00761

THE TIDELANDS CONTROVERSY: A STUDY IN DEVELOPMENT OF A POLITICAL-LEGAL PROBLEM,
William K. Metcalfe.
Syracuse L Rev, Vol 4, No 1, pp 39-89, Fall, 195
51 p, 3 tab, 210 ref.

Descriptors: Continental shelf, *Tidal waters, Administrative decisions, Coastal plains, *Political aspects, Control, Federal government, Interstate

ompacts, *Federal-state water rights conflicts, ublic lands, State governments, *Ownership of eds, Legal aspects, Judicial decisions, Legislation, references (Water rights).

he development of the tidelands controversy as it ecame both a political and legal question and the nterplay of executive, legislative and judicial orces is presented. The executive and legislative spects are emphasized. The origins of the tideands controversy are discussed. The key issue was hether or not the federal government or the states r private individuals owned offshore lands rich in il resources. The Supreme Court finally resolved ne controversy in favor of the federal government. he intense political overtones of the events leadng up to the court's decisions are presented in conderable detail. The repercussions of the decisions re similarly treated. States having oil resources in ffshore lands vehemently argued for state ownerhip of these lands. Republicans and Southern emocrats supported state claim bills in Congress, ut could never muster sufficient votes to override residential vetoes. It was concluded that the 1952 lection would resolve the controversy. Eisenower favored state ownership while Stevenson avored federal ownership. (Pfeiffer-Fla)
W69-00762

OLLUTION OF WATERS.
or primary bibliographic entry see Field 05G.
or abstract, see .
W69-00763

EAL PROPERTY - WATER RIGHTS - LIABILITY FOR DISCHARGE OF SURFACE WATER,
or primary bibliographic entry see Field 04A.
or abstract, see .
W69-00764

ALT WATER FISHERIES AND CONSERVATION - WATER BOTTOMS.
la Stat Sec 370.03 (1967).

escriptors: *Florida, *Ownership of beds, State overnments, Navigable waters, Oysters, Clams, dministrative agencies, Interstate, State jurisdiction, *Commercial shellfish, Public rights, Water aw, Legal aspects, Boats, *Legislation, Beds under ater.

ll beds and bottoms of navigable rivers, bayous, agoons, lakes, bays, sounds, inlets, oceans, gulfs nd other bodies of water within the jurisdiction of lorida are the property of the state except such as ay be held under some grant or alienation previously made. The state board of conservation has xclusive power and control over all water bottoms, not held under some grant or alienation previously made, including any which may revert to he state by cancellation or otherwise. The board ay lease such bottoms to any person irrespective f residence or citizenship, upon such conditions as t may elect to impose. No such lessee shall release, sub-lease, sell or transfer any such water bottom or property. All grants prior to June 1, 1913, made in pursuance of then existing laws are confirmed if the recipient of the grant, his heirs or assigns have complied in good faith with requirements of these laws. (R. Smith-Fla)
W69-00765

THE DEVELOPMENT AND PRESENT STATUS OF WATER RIGHTS AND WATER POLICY IN THE UNITED STATES,
Wells A. Hutchins.
J Farm Econ, Vol 37, No 5, pp 866-874, Dec 1955. 9 p, disc.

Descriptors: *Riparian rights, *Prior appropriation, *Federal-state water rights conflicts, Navigable rivers, Interstate compacts, Groundwater, Percolating water, Legislation, State governments, Federal jurisdiction, History, Water law.
Identifiers: Interstate commerce.

In the East the riparian doctrine prevails. Some western states recognize both riparian and appropriative rights, others appropriative only. Both doctrines show weaknesses. In riparian states a difficult problem is that of the unused riparian right. The appropriative doctrine is plagued with the perpetuation of rights to specific quantities of water regardless of subsequent economic changes. Courts are reluctant to order prior appropriators to make extensive changes in long-used methods of diverting, conveying, and applying water. A new area of development is the enactment of groundwater legislation. More experience with such statutes is needed before appraising their workability. Federal water policies are derived from the commerce power. In some respects federal and state water policies conflict. Examples of coordination, however, include state control over navigability only in the absence of paramount federal control, and construction of reclamation projects with federal funds under water rights acquired pursuant to state laws. (Kahle-Fla)
W69-00766

AN ACT RELATING TO TOWN ROADS AND COUNTY HIGHWAYS: AMENDING MINNESOTA STATUTES 1965, SECTION 164.07, BY ADDING A SUBDIVISION AND MINNESOTA STATUTES 1965, CHAPTER 163, BY ADDING A SECTION.

Minnesota Acts Ch 723 (1967).

Descriptors: *Minnesota, Legislation, *Roads, *Surface runoff, *Ditches, Surface drainage, Highways.

Minn Stat Sec 164.07 and Ch 163 (1965) are amended to direct that town boards and county boards, when considering petitions for vacation of roads, consider the necessity of the lateral ditches along such roads for the drainage of the adjacent lands. Where such boards find that the ditches promote the public health and welfare, they are authorized to retain the right of access to the ditches for their maintenance. Adjacent landowners are prohibited from interfering with the drainage facilities. (R. F. Williams-Fla)
W69-00768

PRESIDENT'S MESSAGE ON CONSERVATION AND WATER MANAGEMENT,
Lyndon B. Johnson.
U S Code Cong and Admin News, Vol 1968, No 2, pp 561-566, April 5, 1968. 6 p.

Descriptors: *Legislation, *Administrative agencies, Water pollution control, *Water pollution treatment, Water quality control, Sewage treatment, Water management (Applied), *Federal government, Standards, Arizona, Colorado, Oil wastes.

The President reviewed past water pollution and mangement legislation and the need for more programs. He asked Congress for action on proposed and pending legislation and more funds for existing programs. The President made the following recommendations: (1) An appropriation of $225 million for grants under the Clean Water Restoration Act to speed the construction of water treatment plants; (2) Legislation be passed to allow the Secretary of Interior to make annual installment payments under this act in addition to lump sum grants to permit the Federal Government to make larger long range construction commitments; (3) That a Safe Drinking Water Act which would establish minimum requirements for public drinking water be passed; (4) The establishment of a National Water Commission which was then in conference committee; (5) Authorization of the Central Arizona Project which would divert waters of the Colorado River to arid portions of Arizona; and (6) Passage of the Oil Pollution and Hazardous Substances Control Act of 1968 which would strengthen previous legislation in this area. (R. H. Watson-Fla)
W69-00770

GARBAGE DISPOSAL AND WASTE ALONG STREAMS.
Ohio Laws 1967, Ch H 152.

Descriptors: *Legislation, *Ohio, *Waste disposal, Domestic wastes, Water pollution control, Administrative agencies, Watercourses (Legal), Streams, Cities, Zoning.
Identifiers: Attorney general, Injunction.

The Act amends sections 3767.32, 3767.33, and 3767.99 of the Revised Code. Section 3767.32 now provides that no person shall place or dispose of garbage, wastes, or anything else of an unsightly or unsanitary nature in any stream, or other watercourse, except those waters which do not combine with natural surface or underground waters, or upon the bank thereof where the garbage is liable to be washed into the water. Certain exemptions are specified. Section 3767.33 provides that no zoning commission, municipal corporation, or other governmental authority, except the water pollution control board, may authorize the placing or disposal of materials in or upon the banks of such watercourses after January 1, 1968, where such disposal would be prohibited under section 3767.32. Such placing or disposal may be enjoined by the common pleas court upon application by the attorney general or other specified officers or agencies. Section 3767.99 provides penalties for violations of certain sections of the Revised Code, including a fine of not less than $25.00 nor more than $500.00, or imprisonment for not more than 30 days, or both, for violation of section 3767.32. (Smodish-Fla)
W69-00771

HANDBOOK OF BASIC WATER LAW (WITH SPECIAL REFERENCE TO LOUISIANA),
Louisiana Water Resources Research Institute, Louisiana State U, Baton Rouge.
George W. Hardy III.
Handbook of Basic Water Law (with special reference to Louisiana) pp A1-A14, B1-B26, C1-C37, June 1966. 77 p, 46 ref, append.

Descriptors: *Louisiana, *Saline water intrusion, Aquifers, Encroachment, Legislation, Judicial decisions, Civil law, *Legal aspects, Groundwater.

A compilation of materials is presented to serve as a basis for the study of possible legal solutions to problems encountered in the study of salt water intrusion into fresh water aquifers in East Baton Rouge Parish, Louisiana. A memorandum discusses the present state of the water law in Louisiana to serve as a basis for seeking answers to legal problems that may arise if groundwater is water from surface streams is imported for use in the Baton Rouge area. Summaries of statutory water law are presented to compare the efforts of Cal, Colo, Fla, Ill, Ind, Neb, N J, Texas, in dealing with the problem of preservation of fresh ground water. A compilation of Louisiana statutory materials and court decisions is presented as a research tool for the evaluation of legislation or other solutions to the salt water intrusion problems in the Baton Rouge area. (Molica-Fla)
W69-00773

DELAWARE RIVER BASIN COMMISSION.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00774

OFFICE OF WATER RESOURCES RESEARCH, DEPARTMENT OF THE INTERIOR.
18 CFR Ch 4, Secs 501-508 (1968).

Descriptors: *United States, *Water Resources Research Act, Legislation, Allotment, Grant, State government, *Universities, *Water conservation, Training, Inspection, Water supply, Hydrologic cycle, Administrative agencies.
Identifiers: Office of Water Resources Research, Agriculture Experiment Stations.

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This act creates a national program of water research. The Department of the Interior controls the Office of Water Resources Research. Funds to establish a research institute are available to each state when associated with a college in that state. These institutes conduct research and train scientists in such areas as the hydrologic cycle, supply and demand of water, water conservation, and increasing water supply. Grants are available when matched with state or other non-federal funds. Grants for research into any aspect of water problems may be given to entities other than the institute. The requirements for obtaining institute allotments and grants to other entities are provided. The Director of the Office of Water Resources Research determines whether applications for allotments, grants or contracts are to be accepted. The Act describes the fiscal and accounting procedures to be used. Various reports by fund recipients are required. Representatives of the Director and of the Comptroller General may conduct audits and inspections of all recipients of funds. (Childs-Fla)
W69-00775

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, DEPARTMENT OF THE INTERIOR.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00776

WATER RESOURCES COUNCIL.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00777

RIVERS AND HARBORS - APPROPRIATIONS PL 90-483.

U S Code Cong and Adm News, Vol 1968, No 10, pp 3505-3528, Sept 20, 1968. 25 p.

Descriptors: *Federal government, *Grants, Navigation, *Legislation, Flood control, *Rivers and Harbors Act, Beach erosion, Basins, Federal budgets, Costs.

Appropriations for the fiscal year 1968-69 under the Rivers and Harbors Act are listed. Thirty appropriations for the improvement of navigation, exceeding $285 million, were approved. Extensive appropriations were also approved to prevent beach erosion throughout the nation. Appropriations exceeding $600 million were approved for flood control measure in thirty areas of the nation. Additionally, $466 million was appropriated for the prosecution of a comprehensive plan for the development of twelve listed basins by the Secretary of the Army. (R. H. Watson-Fla)
W69-00778

AN ACT REORGANIZING AND RENAMING THE RHODE ISLAND WATER RESOURCES COORDINATING BOARD, AND EXTENDING ITS POWERS AND DUTIES.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-00780

BOETTLER V BOARD OF TOWNSHIP TRUSTEES (CIVIL RULE OF SURFACE RUNOFF).
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00782

HATFIELD TOWNSHIP V LANSDALE MUNICIPAL AUTHORITY (WATER WELLS-REASONABLE USE).
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-00784

YOUNG AND SONS, INC V KIRK (MUDFLOW FROM ROAD CONSTRUCTION).
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00785

BODIN V GILL (WATER DAMAGE THROUGH NEGLIGENT DESIGN).
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00786

PAINTER V ALEXANDRIA WATER CO (TRANSFERABILITY OF FLOWAGE RIGHTS).
202 Va 431, 117 S E 2d 674-678 (1961).

Descriptors: *Virginia, Judicial decisions, *Dams, Flow control, Ponding, Competing uses, Prior appropriation, Condemnation, *Relative rights, Easements, Submergence, Water resources development, Flood plains, *Land tenure.

This was a condemnation proceeding by the water company, defendant here, under color of a deed of flooding rights, against Painter, plaintiff, grantee of Pagne. The commissioners' report favoring the water company was accepted by the trial court over Painter's objections, and Painter brought this suit. This court affirmed the decision. The deed between Pagne and the defendant's predecessor created two separate flowage rights in the former company, which vested immediately upon the deed's execution anddelivery. Since the rights had vested immediately, and were not contingent upon the happening of any future event, there was no difficulty arising out of the rule against perpetuities. The sale of such rights to the defendant at a later date was perfectly proper and the company could, under its deed, condemn certain of the plaintiff's lands. A landowner can grant to another an easement running with the land to overflow that land, and such easement is enforceable against later owners. (Blunt-Fla)
W69-00787

PIKE COUNTY BD OF EDUC V BELFRY COAL CORP (INJUNCTION AGAINST DRAINAGE FLOODING).
346 S W 2d 37-38 (Ct App Ky 1961).

Descriptors: Judicial decisions, *Kentucky, *Landfills, Surface drainage, *Obstruction to flow, Floods, Rainfall.
Identifiers: Injunctions, Estoppel.

Plaintiffs owned and operated a garage. Defendant Board of Education owned adjoining property. Originally the land owned by the Board had a lower elevation than the floor of plaintiffs' building. Natural drainage flowed onto the Board's property. The Board decided to build a playground in this area. This was done by filling it with dirt and rock to an elevation approximately four feet higher than the level of plaintiffs' floor. The trial court found that defendant's fill constituted an artificial obstruction to the drainage and substantially contributed to the flooding of plaintiffs' premises during rainfall. The appellate court affirmed, holding there was adequate proof that the change caused an increase in the amount of water cast upon the plaintiffs' premises. Defendant contended plaintiffs were estopped to obtain this relief because they encouraged defendant to spend money in an unsuccessful attempt to alleviate the situation. The court held that the alleged estoppel developed after the suit was filed and that plaintiffs, by insisting that certain steps be taken, were not precluded from claiming that all steps be taken which were necessary to right the wrong committed by the defendant. (Smodish-Fla)
W69-00788

HOLLEY V STATE (OBSTRUCTION OF DRAINAGE).
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-00789

AN ACT AUTHORIZING THE STATE OF INDIANA TO COOPERATE WITH THE UNITED STATES IN THE CONSTRUCTION, OPERATION AND MAINTENANCE OF MULTIPLE-PURPOSE RESERVOIRS.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00790

AN ACT TO PROTECT INTAKE OF PUBLIC WATER SUPPLY.

Maine Public Law Ch 283 (1967).

Descriptors: *Maine, Water supply, *Cities, *Intake, Legislation, Water quality, Regulation, *Utilities, Water pollution sources, Water pollution control.

Title 22 of the Maine Revised Statutes is amended by adding a new section 2437. Authorization is given to any water utility or municipality which supplies water to the public from a lake or pond to mark off an area not exceeding 100 feet in radius around its point of intake. No person shall moor or anchor a boat or carry on ice fishing within such radius. Violation of this provision is deemed a misdemeanor punishable by up to a $50 fine per offense. This act is not to be construed as affecting any private or special law granting a water utility or municipality greater controls for protection of water intakes. (R. F. Williams-Fla)
W69-00791

NORTH CAROLINA WELL CONSTRUCTION ACT.
North Carolina Laws 1967, Ch 1157.

Descriptors: *North Carolina, Legislation, Well regulations, *Groundwater, *Administrative agencies, Administration, *Well permits, Water conservation, Water quality, Withdrawal, Wells, Pumps.
Identifiers: Water quantity.

The Board of Water Resources is authorized to adopt rules and regulations governing the location, construction, repair and abandonment of wells, and for the installation and repair of pumping equipment. Notice and public hearings are required for the adoption of regulations. Prior permission shall be obtained from the Board for proposed wells above a certain capacity or in areas where permission is necessary to protect groundwater resources. Other general standards and requirements which the Board must follow are set out (Sec 87088). The Board is granted rights of entry and access to all property to insure compliance with its regulations. Alleged violators must be served with notice of the violation. A public hearing is required where the alleged violator requests it. The rules and procedure of such hearings are set out, judicial review is provided for, and a penalty of $100 per violation is set. The Director of the Department of Water Resources is authorized to bring suit in the name of the state to enjoin violation of this act or the Board's regulations. (R. F. Williams-Fla)
W69-00795

AN ACT TO IMPOSE A PENALTY FOR THE UNLAWFUL USE OF AN OUTLET OF ANY INLAND PUBLIC WATER.

Laws of New Hampshire Ch 349 (1967).

Descriptors: *New Hampshire, Legislation, *Inland waterways, *Outlets, *Outlet works.
Identifiers: *Penalties.

Chapter 484 of the Revised Statutes relating to lake levels, is amended by adding a new section 484:3-a. A fine not exceeding $1,000 is provided for anyone who disturbs the outlet and the instrumentalities connected therewith, of any inland public water in an unlawful manner under the chapter. This statute is effective September 1, 1967. (R. F. Williams-Fla)
W69-00796

ETTENGILL V TURO (OBSTRUCTION OF VATERCOURSE).

93 A 2d 367-376 (Me 1963).

escriptors: Surface water, Natural flow, Water w, Flooding, Flood damage, Surface runoff, Maine, Ponding, *Damages, Drainage, Leaching, Vells, Water wells, Septic tanks, *Obstruction to ow, Watercourses (Legal).

etween the property of the plaintiff and that of the efendant was a driveway owned by the defendant. n the fall of 1959, defendant raised the grade of e dirveway without providing for sufficient rainage. As a result of this, water was impounded n the rear yard of plaintiffs property and overowed his well and sanitary drainage system. The ourt stated that the heart of the case was whether r not the impounding of the water by the defenant, by virtue of his elevating the roadway, came out by his impediment only of the natural runoff f surface water, or whether it blocked a waterurse. Since only obstruction of a watercourse is tionable the court ruled the case was tried by imlied consent upon the watercourse theory. The ourt affirmed the lower courts judgment for the laintiff, but remanded the case for a new trial sole on the question of damages. (R. Smith-Fla)
/69-00797

OWERS, DUTIES, AND FINANCING OF /ATERSHED DISTRICTS.
hio Laws 1967, Ch H 791.

escriptors: *Legislation, *Ohio, *Watershed anagement, *Water districts, Administration, dministrative agencies, Government finance, inancing, Adoption of practices, Budgeting, loodways, Channels, Water resources developent, Beneficial use, Adjudication procedure, Vatersheds (Basins), Permits, Judicial decisions.
dentifiers: Injunction.

he Act amends several sections of the Revised ode and adds two new ones. Section 6105.01 efines 'floodway' and 'watershed county.' Secons 6105.06 through 6105.08 deal with rocedure for appointing boards of directors for vatershed districts, their composition, terms of ofce, compensation, and the adoption of expendiure budgets for watershed districts. Section 105.11 provides that watershed districts may sue nd be sued as political subdivisions of the state. ection 6105.12 enumerates the means by which he boards of directors may obtain the developent and most beneficial use of water resources. ections 6105.131 through 6105.134 deal with the esignation of restricted channels and restricted loodways, the required written consent of the oard of directors before altering, obstructing, or hanging the grade of such channels and floodvays, and appeal from the board's decision. Secion 6105.15 through 6105.17 deal with the subnission and adoption of expenditure budgets for vatershed districts. Section 6105.22 authorizes the oards of directors to bring suit for injunction gainst violations of sections 6105.01 through 105.21. Section 6105.99 provides a fine of not ess that $100 nor more than $1,000 for violation of ections 6105.13 or 6105.133. (Smodish-Fla)
/69-00798

ARKANSAS LOUISIANA GAS CO V TRAHAN TITLE TO ALLUVION FORMATIONS).

158 So 2d 456-457 (La 1963).

Descriptors: *Judicial decisions, *Louisiana, *Alluvion, Rivers, *Riparian rights, Banks, Water law, Legal aspects, Relative rights.

This case was a concursus proceeding, where the plaintiff deposited in court an amount equal to the value of production from a unit well which it was operating under a mineral lease. There were rival claimants to this fund, and plaintiff desired that the court determine which claimant was entitled to the fund. The property in question, upon which the well was located, was alluvion formation from a river. One claimant contended that its title, purchased from the rival claimant, reached to the bank of the river and that therefore it owned the alluvion formation, and was entitled to the funds. The rival claimant contended that it had retained a strip of land between the river and that which it sold to the first claimant. The case was decided on a factual basis, the legal principle that alluvion belongs to a riparian owner being unquestioned. The lower court found that the first claimant owned all the way to the river bank and was therefore entitled to the funds. The Court of Appeals of Louisiana affirmed. (R. F. Williams-Fla)
W69-00799

MANGROVE ISLANDS AND GROWTH AS LAND - FLOOD CONTROL DISTRICT TAXES,
James Kynes.
1964 Fla Att'y Gen Rep, No 064-61, May 13, 1964. 3 p.

Descriptors: *Mangrove swamps, *State jurisdiction, *Ownership of beds, Administrative agencies, Wetlands, Beds, Submerged plants, *Florida.
Identifiers: *Trustees Internal Improvement Fund.

The question presented here was whether Mangrove Islands were submerged land or uplands; whether title thereto was vested in the State of Florida or in the trustees of the Internal Improvement Fund, and; what lands held by the Trustees within flood control districts were subject to flood control district taxes. The Attorney General replied that since mangroves could only live if their root systems were submerged by the average high tides, that such growths constituted submerged lands until such time as they gathered so much silt and sand as to be no longer covered by the average high tide, and the plants no longer remained green and growing. Since these were submerged lands, title was vested in the Trustees and would so remain even if the growths became uplands. FS 378.30 provides an exemption from flood control district taxes for bodies of navigable water and unreclaimed waters which were meandered. The Mangrove Areas involved in this opinion were within such a meandered area, and consequently the Attorney General felt they should be exempt until they became uplands. (R. F. Williams-Fla)
W69-00800

YOUNGSTOWN MINES CORPORATION V PROUT (OWNERSHIP OF LAKE BED).

124 N W 2d 328-354 (Minn 1963).

Descriptors: *Minnesota, Lakes, Boundaries (Property), *Lake beds, Lake shores, Navigation, *Ownership of beds, Low water mark, Navigable waters, *Mining, Legislation, State governments, Federal-state water rights conflicts, Riparian land, Legal aspects, Water law, Judicial decisions.

Youngstown, pursuant to Minn Statute 6.136, submitted to the Commissioner of Conservation a verified claim for refund of royalties it had paid the state under a mineral lease covering a portion of the bed of Rabbit Lake. The claim for refund was based on a provision of the lease respecting the ownership of the ores mined under it; the findings, conclusions, and judgment stipulated for in an action by the state to reform the lease; and a judgment, entered in a subsequent action, which determined that the state had no right, title, or interest in the bed of Rabbit Lake. The court held that clearly the state in entering into the lease with Youngstown acted not in its sovereign, but in its proprietary capacity, which subjects it to the same liability as other litigants. Under this lease, the state's right to receive royalties was conditioned upon its ownership of the lakebed. The case of State v Adams determined that the fee title to the lakebed was held by the riparian owners. The court affirmed the decision permitting Youngstown to claim the refund. (R. Smith-Fla)
W69-00801

EMINENT DOMAIN: PUBLIC UTILITIES--CONSTRUCTING DAMS FOR WATER POWER.
State of Florida, Tallahassee.

Fla Stat Sec 361.02 (1967).

Descriptors: Dams, Eminent domain, Water power, Florida, Legislation, Condemnation, State government, Water law.

The statute grants the power of eminent domain to persons wishing to construct dams on watercourses in the State of Florida for the purpose of supplying water power for a public utility. This statute allows such persons to obtain land on the opposite side of the water course on which to abut his dam, and to obtain lands which will be flooded by construction of the dam. (Kirkconnell-Fla)
W69-00802

D'ALBORA V GARCIA (OBSTRUCTION OF CANAL).
144 So 2d 911-916 (4 Cir Ct App La 1962).

Descriptors: *Navigable waters, *Ownership of beds, Riparian rights, Canals, Transportation, Water utilization, Water law, Legal aspects.

The plaintiff brought action to enjoin the defendant from obstructing a canal. The main question was whether the canal was navigable. The court held that evidence showing the use of the canal by boats for transportation and commerce proved the navigability of the canal. A test of the navigability of water bottoms is that those which are navigable in fact must be regarded as navigable in law, and they are navigable in fact when they are so used or susceptible to such use or are shown to be capable of commercial use. The defendant was enjoined from obstructing the navigable canal or impeding the use thereof. (Horner-Fla)
W69-00803

PROTECTION OF PORTS AND HARBORS.
State of Florida, Tallahassee.

Fla Stat 309 (1967).

Descriptors: *Harbors, Tidal waters, *Docks, Bays, Rivers, Rocks, Gravels, Piers, Jetties, Piles (Foundation), Bulkheads, *Riparian rights, High water mark, Sands, Mud, Navigable waters, Fish, Bridges, *Florida.
Identifiers: Ports, Wharves, Ballast.

This chapter of the Florida Statutes makes it unlawful to deposit any material in the waters of any bay, port, harbor or river of the state except as so provided. It also prohibits the deposit of any material on a wharf which may wash into the surrounding waters. This chapter provides for the deposit of clear stone and large rocks for use in the construction of wharves, piers, quays, jetties, or bulkhead. It also allows the deposit of any material behind permanent bulkheads which will not allow the material to flow into the protected waters. It goes on to list minimum standards for these bulkheads. Provision is made that nothing in this chapter will be construed to interfere with any rights or privileges previously enjoyed by riparian owners. Exception is also made to allow Escombia, Manatee, and Pinellas Counties to deposit such materials adjacent to bridges as are required to improve fishing. (R. H. Watson-Fla)
W69-00804

WESTON DRILLING COMPANY V TUPPER (OIL LEAKAGE AND WATER POLLUTION).

139 So 2d 361-364 (Miss 1962).

Descriptors: Mississippi, Judicial decisions, *Water pollution, *Soil contamination, *Oil, *Pipelines, Pastures, Cattle, Streams.
Identifiers: Ranches.

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This case concerned water pollution caused by breakage of defendant's oil pipe line on land adjoining plaintiff's ranch. The defendants were held liable for being negligent in maintaining the pipeline and failing to prevent the damage to plaintiff after being notified of the oil leakage. The res ipsa loquitur doctrine was applied against defendant in holding it liable. (Crabtree-Fla)
W69-00805

TRUSTEES INTERNAL IMPROVEMENT FUND--AUTHORITY TO CONSTRUCT DOCKS, PIERS, WHARVES AND SIMILAR STRUCTURES,
Richard Ervin.
Rep Att'y Gen Fla 059-241 Nov 25, 1959.

Descriptors: *Florida, *State jurisdiction, State governments, Legislation, Navigable waters, Riparian rights, Ownership of beds, *Docks, Piers, *Coastal structures.
Identifiers: *Purprestures.

This opinion was requested by the director of the Trustees of the Internal Improvement Fund. He asked what authority the Trustees had in regard to the construction of docks, piers and similar structures in the navigable waters of the state, and if approval was required for each structure or if the Trustees could regulate such construction by the issuance of rules and regulations. The Attorney General replied that there is no statutory authority for riparian or littoral owners to construct docks or wharves into navigable waters, and also according to the common law a wharf was a purprestures, subject to sovereign control. Since the trustees are to administer and control all sovereignty lands, title to which is not vested in some other state agency, it is necessary for upland riparian owners to secure approval of the Trustees before constructing docks or wharves into navigable waters. The trustees may adopt rules and regulations for the construction of docks and wharves in particular areas, allowing their construction without individual permits. However, in the absence of such regulations, specific approval of the Trustees is necessary. (R. F. Williams-Fla)
W69-00806

PARKS V SIMPSON (SHELL DEPOSITS).

137 So 2d 136-141 (Miss 1962).

Descriptors: *Mississippi, *Judicial decisions, Oysters, Shoals, *Legislation, Dredging, Tidal waters, *Ownership of beds.
Identifiers: Public trust doctrine.

In a question turning on statutory construction, the Mississippi Supreme Court held that the provision in the 1960 seafood laws that the Mississippi Marine Conservation Commission, for the purpose of growing oysters, may acquire and dispose of shell seed oysters and other materials did not pertain to shell deposits of dead oysters. The commission acted ultra vires in entering a contract for the sale of shell deposits to which the state holds title as trustee for the people. By decree the court invalidated the contract and enjoined its performance. (MacMillan-Fla)
W69-00807

VAN SZYMAN V TOWN OF AUBURN (DRAINAGE - EASEMENTS).

188 N E 2d 453-460 (Mass 1962).

Descriptors: *Massachusetts, *Drainage, Surface drainage, Drainage effects, Drainage water, *Easements, Water law, Repulsion, Drainage systems.

Plaintiffs appealed from a decree which adjudged that the town of Auburn owns three easements of drainage into the plaintiffs' land, and that the owners of the adjoining land have an easement of flow in one of these drains. The plaintiffs bought the parcel of land from the Whites in 1957. They knew of none of the drains prior to the purchase. The court discussed the facts surrounding each of the drains and concluded that concerning drain number 1 and 2, the Whites were not consulted about the installing of the drain, gave no written or oral permission at any time and never granted an easement to the town. The Whites created an implied easement of drainage appurtenant to the adjoining land and the plaintiffs may not block the flow of this drain. The court reversed the decree of the lower court. (R. Smith-Fla)
W69-00809

PUBLIC PROPERTY, TAXATION OF UPLAND ADJOINING SUBMERGED LANDS - RIPARIAN RIGHTS,
Richard Ervin.
Rep Att'y Gen Fla, 059-188, Sept 16, 1959.

Descriptors: *Riparian rights, Tidal waters, Legislation, *Beds, *Taxes, Legal aspects, *Florida, Administrative decisions.
Identifiers: Upland, Tax deed, Equity.

The Attorney General answered the question, where upland, adjoining submerged lands sold and conveyed by the trustees pursuant to Florida Statutes section 253.12 is taxed and a tax deed is issued pursuant thereto, without the taxation or sale of the said submerged lands, does the purchaser under the tax deed acquire riparian rights, in the negative. The Attorney General cited Caples v Taliaferro, 144 Fla 1, 197 So 861, for the rule that a riparian owner may separate his uplands from his submerged lands and convey both to different grantees or he may sell one and withhold the other. The owner of the submerged lands, notwithstanding the tax deed in question, has the right to fill his said lands. The purchaser under the tax proceeding has his remedy in a court of equity to determine his rights under the tax title. (R. H. Watson-Fla)
W69-00810

CHESARONE V PINEWOOD BUILDERS INC (DRAINAGE SYSTEM).

186 N E 2d 712-716 (Mass 1962).

Descriptors: Eminent domain, Surface water, Damages, *Massachusetts, *Drainage system, Land development, *Artificial watercourses, Water law, Watercourses (Legal), Ditches, *Surface runoff, Rain water, Drainage, Drainage water, Flooding, Surface drainage.

This case dealt with a bill in equity to enjoin the defendants from discharging and throwing water in an artificial stream on the land of the plaintiff and for damages. In 1959 and 1960, the defendant developed his land for several hundred housing units. Defendant, with the approval of the planning board of Framingham and the permission of the town engineer graded his land so that it gradually sloped in a descending plane toward plaintiff's land. The defendant also installed a surface water drainage system which caused all of the surface water from the area to be collected into the drains and then discharged onto the plaintiff's land. The court granted plaintiff's request for damages on the basis that there never was any natural watercourse from defendant's land running over the plaintiff's land. The court found that the cost of correcting the conditon by a proper drain under the plaintiff's land was $28,130.60. There were other innocent parties involved and the court remanded the case for further investigation as to whether injunctive relief should be granted. (R. Smith-Fla)
W69-00811

REQUIREMENT FOR ESTABLISHMENT OF BULKHEAD LINE AS PREREQUISITE TO SALE OF SOVEREIGNTY OFFSHORE AREAS,
Richard Ervin.
Rep Att'y Gen Fla 059-217, Oct 27, 1959.

Descriptors: *Florida, *Islands, State governments, State jurisdiction, *Bulkhead line, *Coasts, Navigable waters.

This opinion was in response to a question from the Director of the Trustees of the Internal Improvement Fund. He asked if it was a necessary prerequisite to the purchase of unsurveyed offshore islands by private parties, that the purchaser first procure the establishment of a bulkhead about such island. The Attorney General replied that the purpose of the bulkhead provisions was to provide and exterior boundary beyond which no sales could be made and no filling take place. The establishment of a bulkhead is necessary, whether extensions into open water are contemplated or not. He concluded that the establishment of a bulkhead could be made a prerequisite to purchase of offshore islands from the Trustees of the Internal Improvement Fund. (R. F. Williams-Fla)
W69-00812

WINSTEAD V DICENZO.
185 A 2d 304-306 (RI 1962).

Descriptors: *Judicial decisions, *Rhode Island, *Riparian rights, Relative rights, *Docks, Legal aspects.
Identifiers: Injunctions.

Winstead, the complaintant, owned land on the bank of a cove, and had erected a wharf out into the cove in connection with his fishing business. When another landowner (DiCenzo), on the same side of the cove, petitioned state officers for permission to build a similar wharf not far from Winstead's, he objected. Permission was granted over Winstead's objection, and he then sought an injunction against DiCenzo and the State officers to prevent construction of the wharf, on the ground that such construction would permanently obstruct his access to his wharf. The lower court dismissed the suit and the Rhode Island Supreme Court affirmed. The court said that the mere finding of inconvenience to complaintant did not constitute substantial deprivation of complaintant's wharf warranting an injunction. (R. F. Williams-Fla)
W69-00813

BRANCH V OCONTO COUNTY (CONDEMNATION).

13 Wis 2d 595 109 NW 2d 105-110 (1961).

Descriptors: Legislation, *Wisconsin, *Navigable waters, Eminent domain, State governments, Local governments, *Ownership of beds, Boundaries (Property), Riparian rights, *Condemnation, Right-of-way, Legal aspects, Beds under water, Ducks (Wild), Hunting, Water resources development, Game birds, Waterfowl.

The lake in question affords no fishing or swimming opportunities, but is excellent for duck hunting. Appellant Branch acquired the property surrounding the lake and only permits access to the lake for a fee. The county was able to purchase land from another owner for a road to the edge of Branch's property. The county board then voted to condemn a piece of land 50 feet wide across Branch's property. It was conceded that the board's purpose was to provide access to the lake for duck hunters. The State of Wisconsin holds the beds underlying navigable lakes in trust for the enjoyment of all citizens and hunting is one of the recognized public purposes for which any navigable water may be used. The court affirmed the circuit court's decision upholding the condemnation action and denying Branch damages to compensate him for the loss of the right to exclude the public from the lake. (R. Smith-Fla)
W69-00814

FISCHER V MACHT (IMPROVEMENT OF DITCH).
114 N W 2d 572-578 (Minn 1962).

escriptors: *Minnesota, *Ditches, *Drainage, iles, Legislation, Legal aspects.

he case involved a petition under Minnesota tatute 106.501 for the improvement of a drainage itch by constructing an open ditch to replace the riginal tile ditch. The petition was granted by the istrict Court. The appellants maintain that since ie new ditch would depart from the old tile ditch various points and take a sharply different ourse, it is not an improvement but a new open itch, the establishment of which is governed by linnesota Statute 106.031. The court held that the etition for improvement of an existing tile ditch by onstruction of an open ditch deviating at some oints from the existing ditch but not involving rainage of any new lands, which met the require-ents of 106.501 was sufficient. (Horner-Fla)
/69-00815

UFORD V UPTON (CONDEMNATION VALUE F DAMSITE PROPERTY).
38 SW 2d 929-933 (Arkansas 1960).

escriptors: Condemnation, *Condemnation alue, *Eminent domain, Compensation, Water w, Judicial decisions, *Dam construction, *Ar-ansas, Dams, Damsites, Reservoirs, Cities, Reser-oir sites, Land appraisal, Market value.

ecause of a severe water shortage, the city elected o negotiate with a certain landowner to secure his roperty for the construction of a damsite to sup-lement the city's water supply. The owner granted ie commission permission to take possession of ie lands needed for the dam's construction, but hen further negotiations failed to bring about an greement on price the commission entered into ondemnation proceedings. Compensation was ac-ordingly set. On appeal the owner alleged that ompensation was insufficient and that the value of ie land should be based upon its availability as a amsite and reservoir. The City argued that the wner should not be allowed to value his property or the very purpose for which the city wished to ondemn it. The court held that the owner had the ight to obtain the market value of the land based pon its availability for the most valuable purpose or which it could be used, whether presently used or the purpose or not. The owner was correct, herefore, in requesting compensation based upon he market value of his land as a damsite, even hough it was presently being used for agricultural urposes. (Kuder-Fla)
/69-00816

OWLEY V KOZE (WATER EASEMENT).
0 Lehigh Co L J 55-63 (Pa Com P1 1962).

escriptors: *Easements, *Water rights, Land enure, Water law, Legal aspects, *Wells, Pennsylvania, Judicial decisions.

he plaintiff brought suit to force the defendant to upply water from a well on the defendant's land. he plaintiff had been using water from the well by irtue of an appurtenance clause in his deed. Due o the lowering of the water table, the well went ry. The defendant dug the well deeper at his own xpense and added a pump. He then refused to upply water to the plaintiff. The court held that he plaintiff was entitled to the natural flow from he well as it existed before it was deepened and his ights could rise no higher than the use of the de-endant's land for that purpose. If the water table were to rise again, the plaintiff could get the service enewed. The defendant could not interfere with he natural flow but the plaintiff had no right to anything more. (Horner-Fla)
W69-00817

SUNNY ISLES OCEAN BEACH CO V BENKE (OWNERSHIP OF BEDS).
126 So 2d 307 (3d DCA Fla 1961).

Descriptors: *Ownership of beds, Beds, Lakes, Real property, Riparian rights, Riparian land, Legal aspects, Water law, *Florida.

The plaintiff formerly owned the land surrounding a small lake. He sold the surrounding land but contended that he continued to own the lake bottom. The court held that the plaintiff's ownership of the lake when he held all of the abutting property did not remain in him when he sold the property surrounding the lake to others. (Horner-Fla)
W69-00818

GAVETTI V WATSON (LIABILITY FOR MAINTAINING ARTIFICIAL LAKE).
49 Del Co 240-252 (Pa Com P1 1962).

Descriptors: *Judicial decisions, *Pennsylvania, *Confined water, Groundwater, Percolating water, *Percolation, Pervious soils, Seepage, Water law, Legal aspects, Damages.
Identifiers: Artificial lakes.

Plaintiff landowners brought suit against their neighbor, Watson, who owned land opposite a road, asking for an injunction and damages. The land naturally sloped from defendant's property to plaintiff's and plaintiff claimed that by enlarging an artificial lake on his property, defendant caused flooding and damage to plaintiff's property. The court found that the swampy, wet condition on the front of plaintiff's property was due to seepage through the dam at one end of the lake and under the road. This seepage was caused by the great water pressure exerted upon the dam and lake bottom by the volume of water contained in the lake, and such seepage was discontinued by drainage of the lake. The court held the defendant negligent because he built and maintained such a large lake without an impervious bottom, and granted the injunction and entered a judgment for damages. (R. F. Williams-Fla)
W69-00819

BANKS V MASON (ATTRACTIVE NUISANCE).

132 So 2d 219-222 (2d DCA Fla 1961).

Descriptors: *Swimming pools, *Drowning, Swimming, Ponds, Streams, *Florida, Artificial watercourses.
Identifiers: *Attractive nuisance doctrine, Trespass, Negligence, Artificial waterbodies.

The plaintiff's three year old son drowned in the defendant's pool and the plaintiff sought recovery under the attractive nuisance doctrine. The court discussed the doctrine and held that the owner of artificial lakes, fish ponds, mill ponds, gin ponds, and other pools, streams and bodies of water are not guilty of actionable negligence unless they are constructed so as to constitute a trap or unless there is some unusual element of danger lurking about them not existent in ponds generally. Swimming pools normally present no hidden danger and the plaintiffs did not allege that the pool constituted a trap or some unusual element of danger. Plaintiff's case was therefore properly dismissed. (Horner-Fla)
W69-00820

BLAKE V U S (RIGHTS TO OYSTER BEDS).

295 F 2d 91-98 (4 CCA 1961).

Descriptors: *Navigable waters, *Federal government, *Ownership of beds, Navigation, Military aspects, Admiralty, Eminent domain, Water law, Legal aspects, Commercial fishing.

The libellants sued in admiralty to recover compensation for the taking of certain oyster beds leased by them in the bed of the York River in Virginia and for damages because of the removal of stakes and buoys in the oyster beds. The court held that the numerous stakes and buoys located in the natural navigable channel of the river were obstructions to navigable capacity and the removal of the obstructions was an improvement of navigation which served not only the purposes of the Navy but the members of the general public who made use of the stream. So long as the general interests of navigation are served, it is irrelevant that special interests of the United States are also advanced. The U S was in the exercise of its dominant power to regulate and control navigation and was privileged to appropriate without compensation. (Horner-Fla)
W69-00821

SIESTA PROPERTIES INC V HART (OWNERSHIP OF LAND FORMED BY HURRICANE).
122 So 2d 218-224 (2d DCA Fla 1960).

Descriptors: *Accretion (Legal aspects), *Avulsion, *Ownership of beds, Boundaries (Property), Real property, Riparian rights, Riparian land, Gulf of Mexico, Hurricanes, Islands, Water law, Legal aspects, *Florida.

The plaintiff owned land on a peninsula off Siesta Key in the Gulf of Mexico. His land was directly across a pass from the defendant's land, located on the Key. A hurricane caused a part of the plaintiff's land to shift and fill in the pass between their property. In a suit to quiet title, the lands were held not to belong to either party. The lands were held not to be accretion and thus the defendant did not gain ownership of the property. The court further held that a landowner's property lines are not enlarged to an extent necessary to take in the new land formed when a part of his land is suddenly and perceptibly deposited upon or against the shore of another riparian owner or upon the bed of an intervening tidal pass belonging to the state. Boundaries do not change when the loss of land occurs by avulsion. Thus, the plaintiff lost the land when it strayed from his boundaries. (Horner-Fla)
W69-00822

BOROUGH OF FORD CITY, PENNSYLVANIA V UNITED STATES (NAVIGATION SERVITUDE AND MUNICIPAL PROPERTY.
213 F Supp 248-255 (DC Pa 1963).

Descriptors: *Navigable waters, *Federal government, Cities, *Eminent domain, Judicial decisions, Condemnation, Damages, Legal aspects, Ownership of beds, Watercourses (Legal), Riparian land, *Water law, Riparian rights.
Identifiers: *Navigation servitude.

Plaintiff brought an action for damage, based on a special act of Congress, for harm to plaintiff borough's sewerage system, brought about by construction of a lock and dam by the U S Government. Plaintiff claimed the damage was caused by the construction raising the ordinary high-water mark and pool level of the river. The court held that the system was private property within the Fifth Amendment, and thus the U S was liable for damage. Defendant claimed that it was not liable because the damage was caused in the course of an exercise of the navigation servitude. This doctrine allows the federal government to appropriate property without compensation when exercising its power over navigable waters in the interest of commerce. Exercise of this power below the high-water mark is not a taking of a private property right. In addition, if land above the high-water mark is damaged, value attributable to its riparian location is not recoverable. But the court found that the water was raised above the high-water mark, and that the riparian location of the injured property was not a factor in its value. (Patterson-Fla)
W69-00823

EXEMPTION FROM TAXATION OF AIR AND WATER POLLUTION FACILITIES.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-00824

TIEDEMAN V VILLAGE OF MIDDLETON (CITY'S DISCHARGE OF SURFACE WATER IN ACCORDANCE WITH NATURAL FLOW).
For primary bibliographic entry see Field 04A.
For abstract, see .

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W69-00826

BEHM V KING LOUIES BOWL, INC (DRAINAGE OF SURFACE WATER).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00827

CHAPPELL V WINSLOW (DIVERSION OF SURFACE WATER).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00828

PENDLETON V STUTTGART AND KING'S BAYOU DRAINAGE AND IRRIGATION DIST (ATTEMPTED WITHDRAWAL FROM DRAINAGE DISTRICT).

360 S W 2d 750-753 (Ark 1962).

Descriptors: *Arkansas, *Judicial decisions, *Drainage districts, Drainage effects, Legislation, *Land tenure.

The Arkansas Supreme Court held that two landowners, who signed a petition for formation of a drainage and irrigation district, were not entitled to have their names removed. The remonstrants moved to have their names withdrawn only after a great deal of work had been done and expense incurred in connection with the project which, the court found, would benefit them indirectly. In the absence of claims of fraud, deceit or misrepresentation in obtaining the signatures, the signatures could not be removed at this point. (MacMillan-Fla)
W69-00829

DAY V MUMMEY (STORM DRAINS).
200 N E 2d 785-787 (1963).

Descriptors: Storm runoff, Surface runoff, Rain water, *Ohio, Floods, *Storm drains, Surface drainage, Cities, *Drainage systems, City planning, Diversion, Land development, Sewers.

This is an appeal on questions of law and fact from trial court's order enjoining the levy of special assessments for storm sewers against plaintiff's properties. The undisputed testimony was that since the installation of a 24 in. storm sewer in 1932, no flooding had occurred on Center Street. Counsel conceded that there had been no appreciable further development of the properties fronting on Center Street that would produce acceleration of water flow there. The court affirmed the decision and held that the claim depends essentially on the effects of acceleration and diversion of the uplands water flow as building occurs and hard surfaces and roof tops promote more and faster runoff at points upgrade from plaintiffs' properties. The individual lower property owner has no obligation to take any such increase of surface water where diversion and acceleration are factors. The city is precluded from assessing any portion of the cost of the 1958 storm sewer upon lands of plaintiffs because these lands were already provided with an adequate sewer. (R. Smith-Fla)
W69-00830

STEINEM V ROMNEY (TITLE TO SANDBARS WHICH GROW BY ACCRETION).
233 Md 16, 194 A 2d 774-778 (1963).

Descriptors: Maryland, Judicial decisions, *Sandbars, *Accretion (Legal aspects), *Ownership of beds, *Riparian land, Navigable waters, Recreation, Storm runoff, Storms.

This was an action with respect to title to a sandbar. The sandbar in question was initially completely submerged in a navigable river and has not attached to the river banks. Because of storms and changes in the river flow it grew by accretion. This growth was lateral in nature so that the sandbar grew in front of plaintiff's property and finally attached itself to defendant's land, which was adjacent to plaintiffs land on the same side of the river. Defendant claimed title to the entire sandbar because it was attached only to his land and not to plaintiffs. It was held that plaintiffs held title to that accretion in front of their property because of their right of access to the river. (Crabtree-Fla)
W69-00831

REUTNER V VOUGA (DRAINAGE).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00832

FURTEK V WEST DEER TOWNSHIP (CLOSING DRAIN RESULTING IN INCREASED SURFACE WATER FLOW).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00833

MUNICIPAL LIQUIDATORS, INC V TENCH (AVULSION AND EROSION).
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-00834

JACKSON V ATLANTIC COAST LINE R R (RIPARIAN'S RECOVERY FOR POLLUTION).
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-00835

ARMSTRONG V WESTROADS DEVELOPMENT CO (SURFACE DRAINAGE).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00836

UNITED STATES V PERMA PAVING CO (OBSTRUCTION OF NAVIGABLE RIVERS).
332 F 2d 754-758 (2nd Cir 1964).

Descriptors: New York, Judicial decisions, *Navigable rivers, *Riparian land, *Land fills, *Mud flows, Bank erosion, Shore protection, Damages, Dredging, Obstruction to flow.
Identifiers: Bronx River.

This was an action by the United States to recover costs it had incurred in dredging from the navigable channel of the Bronx River a shoal which resulted from the misuse of riparian land owned by New York City. The city permitted its lessee to use land along the river as a storage for fill. The city determined that twenty feet of fill could be supported by the land. However, the filling operation caused the riparian land to slide into the navigable channel of the Bronx River. The United States removed the mud slide and recovered costs from the city and from the lessee. (Crabtree-Fla)
W69-00837

PETERS V SHULL (COLLECTION AND DISCHARGE OF SURFACE RUNOFF).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00838

STEVENS V MAYO (OWNERSHIP OF ACCRETION).

166 So 2d 572-575 (4th Cir Ct App La 1964).

Descriptors: *Accretion (Legal aspects), *Ownership of beds, Beds, Riparian rights, Riparian lands, Real property, Boundaries (Property), Navigable water, Water law, Legal aspects, *Louisiana.

The plaintiff brought petitory action against the defendant, who was in possession of a batture on the Mississippi River. The batture was conveyed to the defendants' predecessor in title and later the riparian lot on the river was conveyed to the plaintiff's predecessor in title. The plaintiff claimed that future accretions could not be conveyed, that the batture did not exist at the time of the conveyance to the defendants predecessor, and that the batture belonged to him as accretion to his land. The court held that even if future accretions cannot be sold separately from the riparian estate, the plaintiff did not prove the non-existence of the batture at the time of the sale. (Horner-Fla)
W69-00839

SPICER V WHITE BROS BUILDERS INC (DRAINAGE SYSTEMS).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-00840

HUGUENOT YACHT CLUB V LION (UNDERWATER AND RIPARIAN RIGHTS OF ADJOINING UPLANDS OWNERS).
43 Misc 2d 141; 250 N Y S 2d 548-556 (1964).

Descriptors: *New York, *Judicial decisions, *Riparian rights, Competing uses, *Marinas, Docks, Bulkhead line, *Boundary disputes, Navigable waters.

A yacht club sought to enjoin a commercial marina boatyard operator from using a floating dock near the club's dock and for removal of the floating dock on grounds of zoning ordinance violation and of trespass upon club's underwater and riparian rights. A prior action established that there was no zoning ordinance violation, the defendant possessing the right to continue to use his land for boatyard as a non-conforming use the structure complained of being incident to that use. The Supreme Court determined that club and operator had established their common underwater boundary as being their upland property line extended to the bulkhead line. Under law of riparian rights prior construction and long use of a dock gave the club no right to continue use of the west side dock or to prevent operator from making full use of his riparian rights by construction of a float on a part of lands under water in front of his upland. (MacMillan-Fla)
W69-00841

COMMONWEALTH V HENDERSON COUNTY (DEPLETION RIGHTS UNDER RIVER BED).
371 S W 2d 27-35 (Ky, 1963).

Descriptors: Ohio River, *Ownership of beds, *Patents, *Leases, Oil, Natural gas, Public lands, Boundaries (Property), Local governments, State governments, *Withdrawl, Kentucky, Low water mark, Rivers, Beds.

The discovery of oil and gas under the bed of the Ohio River between the thread of the stream and the Indiana shore gave rise to this case. Claimants to these rights are: the counties bordering the area and their lessees; those claiming under state patents; and claimants under a lease executed by the State Property and Building Commission. The border of Kentucky extends to the north northwest low water mark of the Ohio River while an individual Kentucky landowner only owns to the thread of the river. The state controls the northern or northwestern side of the river and its disposition of these rights involves three statutes: the Patent Statutes; the County leasing Statute; and the Building Commission Statute. It was held that the patentees of this land had no claim because this portion of the state's land was not encompassed by 'vacant and unappropriated' land referred to in the Patent Statute. Lessees of the Building Commission also do not take because the statute does not expressly repeal the counties' historical control over these lands. County lessees do take as the right to

cute depletion leases is implied from the statute. McDermott-Fla)
V69-00842

IUNN V HORVITZ CO (PRESCRIPTIVE IGHTS).
or primary bibliographic entry see Field 04A.
or abstract, see .
V69-00843

IIANUS REALTY COMPANY V GREENWAY RIPARIAN RIGHTS).
93 A 2d 713-716 (S Ct Err Conn 1963).

Descriptors: High water mark, *Riparian rights, Boundaries (Property), Navigable waters, Watercourses (Legal), Water law, *Connecticut, Bulkheads, Marinas, Tidal marshes, Land reclamation, Ownership of beds.

This action involves a parcel of land on the easterly ide of a cove on the Mianus River. In 1937, the ailroad owned the cove and Greenway owned the and on the westerly side. Both parties then had full iparian rights in and to the land below the high vater mark in front of their respective premises. Greenway and the trustees of the railroad entered nto a written agreement establishing a division line etween their properties beyond which neither arty would claim riparian rights or make land by illing in. This line was delineated on a map atached to the agreement. The title passed through arious persons and is presently in Harrison. The ourt examined the deeds granted from the railroad nd concluded that the present owner had no iparian rights since the land had been filled and a ulkhead erected on the 'Line of Ultimate Filling' s delineated on the map. (R. Smith-Fla)
W69-00844

REINHART V LANCASTER AREA REFUSE AUTHORITY (WELLS-WATER POLLUTION).
201 Pa Super 614, 193 A 2d 670-676 (1963).

Descriptors: *Pennsylvania, Wells, *Water wells, Streams, Groundwater, Water table, Inflow, Percolating water, *Water pollution, *Waste dumps, Liquid wastes, Land, Garbage dumps, Pollutant identification, Reasonable use, Judicial decisions.

This action arose as a result of filling operations on and owned by defendant McFalls and leased by him to the other defendant, Lancaster, for the purpose of dumping refuse thereon. Plaintiffs are appealing the grant of a judgment n o v for the defendants following verdicts for money damages in plaintiffs' favor in two actions of trespass brought for contamination of wells located on their respective properties. The court here reversed the judgment and held that the defendants, in bringing polluted material, particularly items such as garbage, red paint, etc, which might permeate the earth and resist filtration, failed to use due care in handling such material when they placed it in close proximity to plaintiffs' land and wells, of which they were aware, and into excavations they had made below the surface of the land, even below the water level of a stream running through the land, and then compressing it into the ground by running trucks over it. Since they had received general warnings about the results of this operation, the effect on the percolating waters was reasonably foreseeable. (R. Smith-Fla)
W69-00845

CRUTCHER V CRAWFORD LAND COMPANY (LEGISLATION).
138 S E 2d 580-584 (Ga 1964).

Descriptors: Water law, Surface water, Land development, Surface drainage, *Legislation, State governments, Surface runoff, *Georgia, Judicial decisions.

This is an alleged trespass and damage suit case resulting from the alleged increasing of the flow of surface water upon the property of the plaintiff by the defendants. The case dealt on a procedural point concerning the 'voluminous petition' submitted here which named several defendants and in the most general terms charged numerous acts without causal connection or common wrong. The court here affirmed the lower court's decision granting a summary judgment in favor of the defendant. It was held, inter alia, that allegations of cutting trees, debris and underbrush and excavating and landscaping land, thereby increasing the flow of surface water on plaintiff's land, were insufficient, as defendants had a right to do all these things to their respective properties. (R. Smith-Fla)
W69-00847

HIGH KNOB, INC V ALLEN (WATER CONTRACT).
205 Va 503; 138 S E 2d 49 (1964).

Descriptors: *Judicial decisions, *Virginia, *Water contracts, Contracts, Supply contracts, Domestic water, Water supply, *Water works.

Allen entered into a written sales contract with High Knob, Inc, to purchase a residential lot. It was provided in the deed that no method of taking water from the ground could be used. There was an oral agreement that High Knob would allow Allen to hook on to its water system for a $200 fee. Allen then constructed a home and hooked on to the water system. However, the company refused the $200 payment and provided a contract with other terms than the oral agreement. When Allen refused to sign, his water service was cut off. Allen sought a permanent injunction to force the company to comply with the terms of the oral agreement. After dealing with various parol evidence problems, the trial court granted the injunction. High Knob appealed and the Supreme Court of Appeals of Virginia affirmed, holding that the company had to furnish Allen with a reasonable quantity of water. (R. F. Williams-Fla)
W69-00848

NANCE V TOWN OF OYSTER BAY (TITLE TO SUBMERGED LANDS).
244 N Y S 2d 916-926 (1963).

Descriptors: *Judicial decisions, *New York, *Ownership of beds, Beds under water, Navigable waters, *Bays, Dredging, Proprietary power.
Identifiers: *Trespass.

This case involved a controversey over title to the bed of Cold Spring Harbor. The Town of Oyster Bay, on the one side, and the Town of Huntington on the other, both claimed title to such bed, and the U S Dredging Company claimed that title was in private owners. The company, under a contract with Huntington dredged the bottom of the Harbor. Oyster Bay, through a taxpayer, brought an action in trespass against Huntington and the company. The court found it necessary to construe the old colonial charters to decide if they granted title to underwater land. In regard to the company's claim, it found that since there was no presumption that deeds to uplands carry title to submerged lands, in the absence of express words to such effect in deeds from Oyster Bay, title to submerged lands never passed to private owners. The original grant to Huntington extended only to the high-water mark on its side of the bay. The court then proceeded to hold that prior decisions had established title to the bottom of the bay in Oyster Bay and the company had trespassed thereon. (R. F. Williams-Fla)
W69-00850

GRANTS TO RIPARIAN OWNERS.

Fla Stat Ch 271 (1967).

Descriptors: *Florida, Oysters, *Riparian rights, Ownership of beds, Beds under water, Boundaries (Property), *Legislation, Water law, Legal aspects, State governments, Highwater mark, Navigable waters, Riparian land, Relative rights, Low water mark, Channels.

Riparian rights are those incident to land bordering upon navigable waters. They are the rights of ingress, egress, boating, bathing, fishing and such other rights as may be defined by law. Such rights are not of a proprietary nature and are appurtenant to and inseparable from the riparian land. The trustees of the internal improvement trust fund are authorized to grant to riparian owners perpetual easements, or easements, licenses and leases for a specified term of years permitting such riparian owners to construct and maintain structures on, in and under the bed of any navigable stream or river owned in whole or in part by the state. This chapter does not apply to lakes except tide water lakes and nothing contained in it should be construed as a release of the title of the state or any of its grantees to any swamp or overflow lands. The state reserves the ownership of all natural oyster beds upon and all minerals and oils in the submerged lands until they are filled in and improved by the riparian owners. (R. Smith-Fla)
W69-00851

BROWN V ALABAMA POWER CO (OBSTRUCTION TO FLOOD EASEMENT).
156 So 2d 153-157 (Ala 1963).

Descriptors: *Judicial decisions, *Alabama, *Easements, Floodwater, Obstruction to flow, Relative rights, Legal aspects, Water law.
Identifiers: Injunctions, *Easement to flood.

Plaintiff Alabama Power Corp purchased a tract of land in fee simple and also purchased an easement to flood adjacent land from the same parties. Subsequently plaintiff's grantors sold the adjacent land, subject to the easement, to defendants. The defendants constructed a dwelling house and proposed to fill a portion of the land to exclude flood water therefrom. Plaintiff sought an injunction to forbid defendant from constructing and maintaining the dwelling house and from interfering in any other way with plaintiff's easement over the property. The trial court granted the decree prayed for, and the Alabama Supreme Court affirmed. A person who takes land subject to an easement must not interfere with dominant owner's enjoyment of such easement. If such were allowed, the servient owner could nullify the easement. (R. F. Williams-Fla)
W69-00854

CONSTRUCTION OF SEC 253.0013 (2) F S,
Florida, Office of the Attorney General, Tallahassee.
Richard Ervin.
Rep Fla Att'y Gen 060-111, June 30, 1960.

Descriptors: *Florida, Bulkhead line, Navigable water, *Landfills, Land forming, State jurisdiction, Legislation, Federal government, *Administrative decisions, Public rights, *Permits.
Identifiers: Florida Bulkhead Law, Corps of Engineers.

This opinion was in response to five questions from the Director of the Trustees of the Internal Improvement Fund which were concerned with construction of Fla Stat 253.0013 (2). That statute authorizes an exception to the application of the bulkhead law for persons who hold fill permits granted by the U S Corps of Engineers prior to June 11, 1957. The Attorney General replied that since this was an exception to a statute, it must be strictly construed, and that the holder of an unexpired U S permit, who is otherwise qualified under 253.0013 (2) may fill without advertisement for objections as required by the bulkhead law. A U S permit expired or extended subsequent to June 11, 1957 does not meet the requirements of the exception. Changes in bulkhead lines after June 11, 1957 will not affect

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rights under U S fill permits, and such permits are not personal to the holder, but run with the land. Any change in the provisions of the permit, such as extention of time or area covered, will disallow the holder of such permit to be exempted from the requirements of the bulkhead law. (R. F. Williams-Fla)
W69-00857

CONOLEY V NAETZKER (TITLE CHALLENGE TO RECLAIMED LAND).

137 So 2d 6-10 (2d D C A Fla 1962).

Descriptors: Judicial decisions, *Florida, Riparian rights, *Reliction, Accretion, *Boundaries (Property), *Land reclamation, Dry beds, Lakes, Drainage effects, Drainage wells, Navigable waters.

Judgment for plaintiffs in an ejectment action was affirmed on appeal. The land in question was a lake bottom and the cause was mainly tried on the issue of what had caused the lake to recede. The defendants claimed title by the doctrine of reliction, asserting that the water receded gradually and the land thus formed a natural accretion to the land to which they hold title. The plaintiffs' contention was that the recession of the waters was perceptible and accomplished by drainage, thereby rendering the lake bed reclaimed land which vested in the state. The court, not reaching the question of reliction, affirmed the lower court's ruling that the finding by the Trustees of the Internal Improvement Fund that the subject land was reclaimed lake bottom was not subject to collateral attack in a suit between private parties in the absence of a showing of an abuse of discretion or that defendants were never afforded an opportunity of making a direct attack on the sale. (MacMillan-Fla)
W69-00858

TRUSTEES OF THE I. I. FUND - SALE OF SUBMERGED LANDS.
Florida, Office of Attorney General, Tallahassee.
Richard Ervin.
Rep Att'y Gen Fla 059-1, Jan 1, 1959.

Descriptors: Channels, *Bulkhead line, *Spoil banks, Beds, Riparian rights, Legislation, Islands, Access routes, Artificial watercourses, Sand bars, Navigable waters, High water mark, *Tidal waters, *Florida.

The Attorney General gave opinions to two questions. The first question was does a bulkhead line established so that it precludes 'A' from filling adjacent to his upland permit 'B', an adjoining upland owner who is not so precluded, to purchase that part of a spoil bank which extends in front of 'A'S' upland. This question was answered in the negative. The bulkhead act gives only the upland owner a preference to purchase the submerged land riparian to his upland, i e, that lying between his upland and the channel. Adjoining upland owners have no more preference than the general public to purchase this land. The second question was may a spoil bank, separated from the mainland by an artificial channel, be sold at competitive bids rather than to the upland owner. The Attorney General answered in the affirmative, stating that when an artificial channel has existed for a number of years, it established the limits of riparian rights. Thus the trustees of the internal improvement fund may sell at competitive bids those submerged lands which are separated from the mainland by artificial channels. (R. H. Watson-Fla)
W69-00861

ADOPTION OF CHANGE OF BULKHEAD LINE BY MUNICIPALITY SINCE EFFECTIVE DATE OF SECTION 253, FLA STAT.
Florida, Office of the Attorney General, Tallahassee.
Richard Ervin.
Rep Att'y Gen Fla 059-176, Sept 3, 1959.

Descriptors: Legislation, *Bulkhead line, *Cities, *Riparian rights, *Florida.
Identifiers: Charter, County commissioners.

The question asked of the Attorney General was, 'May a municipality, under charter provisions in force and effect when sec 253.122, F S, was enacted, adopt or charge a bulkhead line without complying with said section.' The Attorney General's opinion was that the above question should be answered in the negative, unless the municipality had been relieved from complying with sec 253.122, by legislation adopted subsequent to June 11, 1957. (R. H. Watson-Fla)
W69-00863

PETITION OF SUFFOLK COUNTY WATER AUTHORITY (POWER OF THE WATER POWER AND CONTROL COMMISSION).

12 App Div 2d 198, 209 NYS 2d 978-982 (1961).

Descriptors: Judicial decisions, *New York, *Water supply, *Administrative decisions, *Administrative agencies, Water districts, Public utilities districts, Competition, Regulation, Relative rights, Public utilities, Cities.

Two public water supply agencies sought future service of the same territory. The legal right of the Water Power and Control Commission to rearrange its formal approval and authorization to provide water service given to petitioner Suffolk County Water Authority was challenged. Petitioner had notice of an intention by the Town of Huntington to service an area within the town which petitioner sought to serve, and clear objection by the town to petitioner's application to serve this area. Added to this was an explicit reservation by the Commission in its approval of petitioner's application to the effect that the Commission might exercise adversely to petitioner a 'right to alter the boundaries of the area' and to grant 'other' authorizations in the same territory. These reservations referred to the activities of the Town of Huntington noted in the same proceedings in which petitioner obtained its authorization. This was followed shortly by the town's action seeking legal status to extend the territory of its water district. The court held that petitioner had not demonstrated that the Commission's decision was unjust, inequitable, arbitrary, or capricious, and confirmed the determination. (Smodish-Fla)
W69-00865

GELLENTHIN V J AND D INC (DAMAGES FROM WATER RUNOFF).
71 N J Super 226; 176 A 2d 515-520 (1961).

Descriptors: *Runoff, *Reasonable use, *Alteration of flow, Repulsion (Legal aspects), Drainage water, *Surface runoff, Easement, Legal aspects.

The plaintiff was injured while walking on a public sidewalk when he slipped on ice that had been formed from water running off the defendants property. The court held that the 'reasonable use' doctrine was applicable. Each possessor is legally privileged to make a reasonable use of his land, even though the flows of surface waters is altered thereby and causes some harm to others, but incurs liability when this harmful interference with the flow of surface waters is unreasonable. The issue of reasonableness is a question of fact to be determined in each case upon a consideration of all relevant circumstances. The court affirmed the judgment for the defendant. (Horner-Fla)
W69-00866

PEOPLE V BROEDELL (OWNERSHIP OF LAND).
365 Mich 201, 112 N W 2d 517-520 (1961).

Descriptors: *Ownership of beds, *Submerged Lands Act, *Beds, Low water mark, High water mark, Boundaries (Property), Water level fluctuations, Real property, Patents, Riparian rights, Riparian lands, Legal aspects.

The case involved a dispute over the ownership of two lots on Lake St Clair. The State claimed that the lots, which had been filled in by the defendant, were submerged lands in 1837 when Michigan was admitted to the Union and thereupon became the property of the state through the Submerged Land Acts. The court said that the decision was not controlled by the high water mark or the low water mark theory or by the philosophy of a movable freehold. It held that if the lots were within the boundary of a land patent from the U S to the defendants predecessor in title, dated 1811, no title passed from the U S to the State of Michigan upon its admission to the Union in 1837, even if the lands were submerged at that time, because it then no longer belonged to the United States but to the successors of the original grantee. The court remanded the case for the trial court to make a finding on the question whether the lots were within the description of the patent. (Horner-Fla)
W69-00868

TONKINS V MONARCH BLDG MATERIAL CORP (NAVIGABILITY OF A STREAM).
347 S W 2d 152-158 (Mo 1961).

Descriptors: *Missouri, Judicial decisions, Damages, *Streams, Streambeds, Ownership of beds, *Navigable waters, Non-navigable waters, Riparian rights, Boundary disputes, Boundaries (Property).

Plaintiff alleged that defendant corporation had wrongfully removed sand from the portion of a river bed lying between plaintiff's bank and the thread of the stream. Plaintiff contended that the river was non-navigable where it passed his property, and therefore he owned the river bed as well as the bank at that point. The defendant denied that (1) the river was non-navigable; and (2) it had removed sand and gravel on the plaintiff's side of the thread of the stream. This court affirmed the verdict for defendant. Since the plaintiff alleged that the river was non-navigable, it was his burden to prove it. Each determination as to navigability must rest on the facts of the particular case. A stream need not be navigable in its entirety to be classified as navigable. Navigability must be determined by the capability for use by the public for transportation and commerce, rather than the particular extent and manner of that use. (Blunt-Fla)
W69-00869

BERNARD V STATE (SUIT TO RECOVER VALUE OF LAND TAKEN FOR PUBLIC PURPOSE).
127 So 2d 774-781 (Ct App La 1961).

Descriptors: *Drainage, *Ditches, *Eminent domain, Damages, Appropriation, Canal construction, State governments, Excavation, *Louisiana, Judicial decisions, Condemnation, Compensation.
Identifiers: Public purpose, Servitude, Police power.

Court of Appeals affirmed the trial court's award of damages for the taking of a portion of plaintiff's land for a drainage ditch. The ditch was along the edge of plaintiff's land bor0ering a public road. Damages were awarded for the value of the land appropriated, cost of constructing a bridge to the road, and decrease in the value of the property. Although the state cannot be sued without the consent of the legislature, if it appropriates land by eminent domain it must pay just value of the land. The appropriation of plaintiff's property for the drainage ditch did not constitute the exercise of the state's police power entitling the state to take such property without compensating the owner. The state was not entitled to be decreed the owner of the property used, but was entitled only to a servitude for drainage purposes over that portion of the property affected by the actual excavation. (H. Watson-Fla)
W69-00871

MCKNIGHT V BROEDELL (TITLE TO RIPARIAN LAND).

212 F Supp 45-53 (D C Mich 1962).

Descriptors: *Ownership of beds, *High-water mark, Boundaries (Property), Real property, Federal government, State governments, Navigable waters, Water law, Legal aspects, Grants.

As a defense to an action for payment on a contract to purchase riparian land, the defendant claimed the title was unmarketable because the State claims ownership of a portion of the land. The land in question borders Lake St. Clair and part of the land is within the ordinary high water mark of the lake, having been filled in subsequent to 1923 thereby converting it into land suitable for building purposes. The question is whether the original grant from the U S to one Abbot in 1810 included the land claimed by the state or whether the grant to Abbot only included land to the ordinary high water mark of the lake. If the latter, then the title to the bed of the lake below the high water mark went to the State upon its admission to the Union. The court held that it was a factual question whether the lake had risen and covered the land in question since 1810 or the original surveyor had erred. Since a purchaser is not required to buy land which he might later have to defend title to, the title was unmarketable. (Horner-Fla)
W69-00872

JONES V HOGUE (APPORTIONMENT OF ACCRETION).
129 So 2d 194-203 (La 1960).

Descriptors: *Accretion (Legal aspects), *Boundaries (Property), Real property, Riparian land, Riparian rights, Water law, Legal aspects, Ownership of beds, Navigable water, Boundary disputes, *Louisiana.

The court was asked to apportion an alluvial formation that had formed in front of the riparian property of the parties. When alluvion formed in front of the estates of riparian owners is to be divided, two objects are to be attained: (1) each owner should receive a fair proportion of the area; and (2) each should receive a fair proportion of the new frontage on the water. The court must take each case as presented and order an apportionment by the method which will most nearly attain the two objects and do justice to the parties. In this case, there was no showing that river frontage had any importance for commerce or navigation, so the court used an area method of apportionment. The alluvion was divided to give each party that portion of the entire area (as it existed at the time the action was instituted) as the length of the original front line of their property bears to the length of all the property to which the alluvion was attached. (Horner-Fla)
W69-00873

AN ACT PROVIDING A PENALTY FOR WELL DRILLERS WHO FAIL TO SUBMIT A REPORT TO THE WATER RESOURCES COMMISSION UPON COMPLETION OF EACH WELL.
Connecticut Public Act No 735 (1967).

Descriptors: *Connecticut, *Well regulations, Well permits, *Water wells, Wells, Drilling, Water law, Legal aspects, Legislation, State governments, Administrative agencies, Subsurface waters, Public health.

Section 25-9 of the 1965 supplement requiring registration of well diggers, the acquisition of permits, and the submission of a report when a well is completed is expanded. The addition provides that if the Water Resources Commission ascertains that a report has not been submitted within sixty days after the completion of a well, the Commission shall notify the driller that he must forfeit $25. (Horner-Fla)
W69-00875

AN ACT TO AMEND 29.05 (1) AND TO CREATE 30.125 OF THE STATUTES, RELATING TO CUTTING WEEDS IN NAVIGABLE WATERS AND PROVIDING A PENALTY.
Wisconsin Laws of 1967, Ch 185.

Descriptors: Legislation, *Wisconsin, *Weeds, *Navigable waters, Lakes, Lake shores, *Remedies, Floating, State jurisdiction, State governments, Administrative agencies.

The State of Wisconsin has made it a nuisance to cut and fail to remove weeds from navigable waters. Violators may be penalized by fine, imprisonment or both. This shall not apply, however, where lake property owners, incorporated under specified statutes, decide at an annual meeting that every such property owner shall remove weeds floating to his respective shore. The State Conservation Commission and its deputies are authorized to enforce this law. (Geraghty-Fla)
W69-00877

WICKOUSKI V SWIFT (USE OF POND SURFACE).
203 Va 467; 124 S E 2d 892-895 (1962).

Descriptors: *Ownership of beds, *Riparian lands, *Riparian rights, Beds, Ponds, Lakes, Surface waters, Boundaries (Property), Dams, Water utilization.

The complainant sought to enjoin the defendants from using the surface of his portion of a fresh water lake. The question was whether the complainant had exclusive control and use over his portion of the bed of the pond and had a right to erect a fence on his boundary line across the pond. The court distinguished between a situation where the riparian owner's property was bounded by a pond and one where each owner owned a part of the submerged land beneath the pond. In the former situation, each owner has title to the bed to the middle of the pond and each owner may use all of the surface water. In the latter situation, as in the case at hand, the owner of a portion of the bed with distinguishable boundaries is entitled to exclusive control and use of the waters above his portion and has the right to erect a fence. (Horner-Fla)
W69-00878

TRUSTEES OF GREEN BAY LEVEE AND DRAINAGE DISTRICT NO 2, LEE COUNTY V ALEXANDER (REASSESSMENT OF DRAINAGE DISTRICT).
108 N W 2d 593-601 (Iowa 1961).

Descriptors: *Iowa, Civil law, *Drainage districts, Judicial decisions, Leases, Contracts, *Assessments, Levees, Ditches, Drains, Taxes.

When the drainage district was being established, the defendants' predecessors in title filed remonstrances against the establishment of the district, basically on the ground that their lands would not be benefited by the creation of the district. In consideration of their concessions, the contract establishing the mutual district provided that the defendants' predecessors in title were to be assessed only for levees, ditches and drains wholly on their lands and an additional five cents per acre annually for maintenance after completion of construction. Forty-two years later, the trustees of the district passed a resolution requiring reclassification of all land subject to assessment in the district. The trustees, plaintiffs here, petitioned the court for a declaratory judgment permitting them to reclassify the land in excess of five cents per acre annually, according to benefits received. The court denied the petition and held that the contract of predecessors of title of both plaintiffs and defendants was binding on them, and the fact that some of the land has been subsequently transferred by means of a tax title was not a change in circumstances that would free the trustees of the district from prior restrictions or covenants. The establishment of a mutual drainage district by contract did not violate a prohibition against any lease or grant of agricultural land for over twenty years. (S. Scott-Fla)
W69-00887

DRAINAGE COMMISSIONERS OF HAMMOND MUTUAL DRAINAGE DISTRICT V PONDER (ANNEXATION BY DRAINAGE DISTRICT).
20 Ill 2d 351, 169 NE 2d 784-787 (1960).

Descriptors: Administrative decisions, *Illinois, Civil law, *Drainage districts, Judicial decisions, Drainage programs, *Assessments, Tile drainage, Ditches, Drainage engineering.
Identifiers: Farm Drainage Act.

The drainage commissioners of a mutual drainage district passed a resolution charging landowners within the district with an additional assessment for repairs, maintenance and operation of the drainage system. The appellant objected to the assessment against her property, claiming that her property did not drain into the ditches of the district, and that neither she nor her predecessors in title had agreed to include the land in the drainage district. The court found that improvements on the appellant's property drained naturally and by tiles into the district drains. The construction and connection of drains from appellant's land into the district drains and the resulting benefit to the land effectively annexed it to the district. It is lawful for the commissioners of a drainage district to require additional assessments to repair, maintain, operate or improve the drains and other works of the district without prior authorization of the court, provided it does not involve a substantial or material enlargement or alteration of the system. (S. Scott-Fla)
W69-00890

BOROUGH OF ISLAND HEIGHTS V PRESBYTERIAN CAMPS AND CONFERENCES, INC (ASSESSMENT OF SUBMERGED LANDS).

68 NJ Super 291, 172 A 2d 228-231 (1961).

Descriptors: *New Jersey, Civil law, Judicial decisions, Beds, Riparian land, *Riparian waters, Landfills, Reclamation, Riparian rights, Beds under water, *Ownership of beds, *Assessments, Taxes.

Respondent owns upland, tax-exempt property. Adjacent to this upland property respondent holds underwater property under a grant from the State of New Jersey, with the right to fill in such underwater land and retain it for its exclusive private use. The Borough of Island Heights separately assessed the riparian rights for taxation. The court affirmed this assessment on the ground that the respondent had legal title to the lands under a riparian deed from the state. Respondent's ownership was not limited to a right to reclaim and fill in such lands that would not ripen into ownership until the right was exercised, but rather was in the nature of a fee, with no ownership remaining in the state. (S. Scott-Fla)
W69-00892

TRUSTEES OF INTERNAL IMPROVEMENT FUND V LOBEAN (SALE OF SUBMERGED LAND).
127 So 2d 98-104 (Fla 1961).

Descriptors: *State governments, *Judicial decisions, *Beds, Taxes, Legislation, High water mark, *Florida.
Identifiers: Estoppel by deed, Deeds, Equity.

Plaintiff sought to enjoin Trustees from selling submerged lands under FS 253.12 which had previously been conveyed erroneously to the plaintiff under the Murphy Act. The Murphy Act authorizes the state to sell land with delinquent property taxes in order to keep the land on the tax rolls. The state could not sell the land in question under the Murphy Act because it was submerged land which was not subject to a property tax. The Trustees of the Internal Improvement Fund were legally

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estopped by deed from denying the validity of the Murphy Act deed to submerged land, in absence of circumstances sufficient to prevent operation of legal estoppel against the state. (R. H. Watson-Fla)
W69-00895

95-1401 RIGHT OF WAY, DAMAGES FOR, 95-1402 GRANTS OF LAND, 95-1403 GRANTS FOR FERRY, 95-1404 VALUE OF LAND, HOW ESTIMATED.

95 Ga Code Ann Secs 1401-1404 (1967).

Descriptors: *Georgia, Eminent domain, *Grants, *Condemnation value, Condemnation, Bridges, State jurisdiction, Legislation, Land appraisal, *Right-of-way.

Sec 95-1401 provides that the damages for rights of way are to be assessed in the same manner as for public roads and private ways. Sec 95-1402 provides that grants of land on watercourses, with the appurtenances, convey no right to establish a public bridge or ferry. Sec 95-1403 provides that the grant of a ferry franchise conveys no right to build a bridge, or the converse. Sec 95-1404 provides that in determining the value of land taken for a bridge, its prospective value as a bridge site and its present value as a ferry, if one is in use, may be taken into account in determining compensation due. (R. F. Williams-Fla)
W69-00903

WISE MANAGEMENT OF NORTH CAROLINA WATER RESOURCES THROUGH LAW.
North Carolina Department of Natural Resources, Raleigh.

North Carolina Board of Water Resources Final Report, pp 1-53, April 1967. 54 p, 7 ref, 7 append.

Descriptors: *North Carolina, Federal government, *Legislation, Well permits, *Well regulations, Water conservation, Water control, Water demand, Water consumption, *Water resources, Water rights, *Watersheds (Basins), Water storage, Water table.

This report on the need for water legislation is the final report in response to directions issued by the 1965 General Assembly of North Carolina. The instructions given specified a study of the need for state regulation of water usage. This report is based on hearings held in each part of the state. The major Board finding is that a need for water use control exists in N C and a number of geographical areas face a significant potential need for early application of controls. The areas are then identified. The remedies proposed by the Board include legislation to provide: (1) A procedure to identify areas where water demands and problems require special action, a system to establish specially designed controls for these areas to include use permits, and provisions to assure due process; (2) A procedure for coordination of use of raw water supply sources so that maximum storage for public water supply may be included in federal projects; (3) A system of reporting water use; (4) Standards for well construction, abandonment, permits for large wells, etc; (5) Dam safety and coordination; (6) Educational program for flood plain management; (7) Minor changes to well driller registration; and (8) A state-wide well driller licensing law. (R. H. Watson-Fla)
W69-00912

FOCUS ON THE HUDSON.
Department of the Interior, Washington, D. C., Bureau of Outdoor Recreation.

In Bureau of Outdoor Recreation, Government Printing Office, Washington, D. C., 1966, 50 p, 65 photo, 1 map, 6 ref.

Descriptors: *Water resource management, Recreation, Project planning, Federal project policy, Political aspects, *Outdoor recreation, National historic sites, Federal jurisdiction, Social needs, Jurisdiction, Scenic easements, Interagency cooperation, River basin development, Local governments, Highway beautification, Fish conservation.
Identifiers: Hudson River, Lower Hudson Waterfront, Hudson Highlands National Scenic Riverway.

The main emphasis of the report is on the development and maintenance of the recreational value of the Hudson. Basic issues of water pollution, inadequate public access to the river, uncoordinated approaches to planning, and conflicting land usage are discussed in light of their effects on the recreational environment. It is recommended that the States of New York and New Jersey amend legislation, to permit State Zoning review and control over local municipalities along the river, and amend taxing policies to encourage use of conservation easements and land use tools for preservation of historic sites. A land acquisition program is proposed to develop and revitalize the waterfront, which has fallen into disuse in many areas. Possible programs for the protection and development of fish and wildlife are presented. Industrial, commercial, residential, and institutional land uses should be fitted into an overall plan for preserving and protecting the scenic and recreational values of the Hudson. To this end a Federal-Interstate Compact is recommended. The scope of its responsibilities, jurisdiction, and authority is defined. (Gargola-Chicago)
W69-00949

WATER RESOURCES MANAGEMENT IN MARYLAND.
Maryland Department of Water Resources, Annapolis.

The Water Resources Study Committee, University of Maryland, 1967, 87 p, 6 photo, 3 tab, 1 fig, 75 ref.

Descriptors: *Water policy, *Water resources management, *State governments, Water supply, Water rights, Water law, Appropriation, Project planning, Regional analysis, Future planning, Coordination, *Adoption of practices, Decision making, Administrative agencies, Flood plain zoning, Long-term planning, Water resources development.
Identifiers: Maryland.

Initially given is a brief summary of nineteen recommendations for overall water resources development in Maryland. Particular opportunities and problems are discussed. Water rights and regulations are reviewed and limitations of existing laws are pointed out. What is needed to facilitate solution of these problems and inadequacies is an overall water resources program for the entire state. For the development of an overall program the relationship between available resources and projected alternative uses must be defined. To this end, eleven suggestions are made to define the responsibilities of the Department of Water Resources: (1) overall planning, (2) data collection, (3) water quality surveillance, (4) sedimentation control, (5) information and education, (6) appropriation of dam and reservoir permits, (7) revision and review of laws, (8) efficiency of sanitary service in metropolitan areas, (9) participation in interstate water resources development, (10) state coordination of federal assistance, and (11) research in water development problems. (Gargola-Chicago)
W69-00955

ORGANIZATION FOR COMPREHENSIVE RIVER BASIN PLANNING: THE TEXAS AND SOUTHEAST EXPERIENCES,
Michigan Univ., Institute of Public Administration.
Robert H. Pealy.
University of Michigan, Ann Arbor, 1964, 164 p, 12 tab, 36 ref.

Descriptors: Project planning, *Adoption of practices, Evaluation, *River basin planning, *Decision making, Political aspects, Institutional constraints, Municipal water, Non-structural alternatives, Coordination, Administrative agencies, Water management, Adoption of practices, Multiple purpose projects, Project planning, Attitudes, River basin commissions.
Identifiers: U. S. Study Commission (Texas), U. S. Study Commission (Southeast River Basins).

Through a study of two experiences in comprehensive river basin development, it is hoped that new insights can be gained concerning the nature of planning and the organizations which do it. Assessments of both the Texas and Southeast River Basin Planning Commission is done through investigation of the constraints and influences which limited or prescribed their activities. Past traditions of planning and the legal framework in both instances are reviewed. The background and attitudes of Chairmen, Commissioners, and staff members who were responsible for major decisions was studied. Specialities of the staff and the number of workers through time is studied in relation to effects on the decision-making process. Comparison is made between the two agencies, and it is shown what major decisions affected the final plans, the process by which they were made, and why. For each commission the physical, economic, and political background is studied. The policy procedures and organization for operations is analyzed. In conclusion, the Texas Commission emerges as more an agency coordinating device while the Southeast Commission performs the more intended function of a planning organization. (Gargola-Chicago)
W69-00965

RIVERS AND REGIONALISM IN NEW ENGLAND,
Massachusetts Univ, Amherst. Bureau of Government Research.
Edwin Andrus Gere.
Booklet, University of Massachusetts, 1968, 71 p, 1 map, 87 ref.

Descriptors: Water resource development, Federal project policy, Project purposes, Project planning, *Federal jurisdiction, State jurisdiction, Federal government, Political aspects, Local governments, River basin planning, State governments, *Administrative agencies, Decision making, *River basin commissions, Interagency cooperation, Institutional constraints.
Identifiers: New England Interstate Water Pollution Control Compact, New England-New York Interagency Committee, Northeastern Resource Committee, New England Regional Planning Commission, New England.

Contrary to the allegation that the federal government is crushing state powers, this study theorizes that the federal government is actually strengthening state governments by openly encouraging the process of regional interstate cooperation. To test this theory, the study proceeded with a historical and developmental examination of federal activity in flood control, water pollution control, and water resource management. The nature of federal participation in regional cooperation for solution of these problems is shown to be strong, persistent and many-faceted. Basic formal mechanisms discussed are interstate compacts and direct congressional statutes, from which additional mechanisms are generated. The most appropriate description of the emerging federal role in regional planning, is that it is facilitating and enhancing state cooperation. These conclusions are derived from a study only of the New England region, and are limited to federal activity for the region. (Gargola-Chicago)
W69-00966

WATER POLLUTION CONTROL IN WASHINGTON,
Washington Univ., Seattle, Ctr. for Urban and Regional Research.
L. A. Powe.

Reprinted separately as Univ. of Washington Reprint 13. Washington Law Review, Vol. 43, 1967, p 425-454, 1 append, 190 ref.

Descriptors: Water Pollution Control Act, Legal aspect, Pollution abatement, State governments, Federal governments, Jurisdiction, Water law, *Water pollution sources, Water pollution control, Water permits, *Paper pulp wastes, Pulp and paper industry, Regulation, Political constraints.
Identifiers: Puget Sound (Washington).

Reported are the Washington Pollution Control Commission's attempts to secure improved water quality in the Puget Sound area. Since the pulp industry is the major polluter of the region, the emphasis of the report is on attempts to control this industry. A history of the Commission's past efforts to control pollution through legal methods is reviewed. The permit system, enacted in 1955, is discussed in relation to the legal difficulties it encountered from the pulp companies. It was contended that the attempts to control their waste discharges represented a violation of their rights. Cases which relate to the validity of the Water Pollution Control Act, and its constitutionality are reviewed. Although it seemed by precedent that these allegations were unfounded, legal problems developed. Because of the difficulties encountered there has been little enforcement action since 1962. Certain legal developments in Federal and State law have strengthened the Water Pollution Control Act, which gives promise to the future. (Gargola-Chicago)
W69-00967

SUMMARY REPORT ON TITLE TO BEDS AND USE OF NAVIGABLE STREAMS AND LAKES IN IDAHO,
Idaho Univ., Moscow, College of Law.
Thomas R. Walenta.
Water Resour Res Inst Rep, Dec 1966. 35 p. OWRR Project A-010-Ida.

Descriptors: *Water policy, Navigable rivers, Water zoning, *Water law, Water levels, Lakes, *High-water mark, *Riparian rights, Lake beds, Lake shores, Streambeds, Legislation.

Federal and State laws and statutes governing the ownership and control in Idaho of the beds of navigable streams were studied together with their waters. State title to beds was rejected in 1908 by the Idaho Supreme Court in Johnson vs. Johnson; 14 Idaho 561; then in 1915 this was reversed by another court action. Navigability of streams and lakes was studied and laws explained as pertaining to use of the beds of those streams and lakes. Indian treaties and rights were also studied as related to ownership of the beds of streams. Proposed legislative changes and recommendations were pointed out. A discussion is also presented on the legislative role in the development of water resources of Idaho. (Warnick-Idaho Univ)
W69-00995

THE MUNICIPALITY AS A WATER-POLICY DETERMINING ENTITY,
California Univ., Los Angeles, Pol Sc Dept.
Winston W. Crouch.
Water Resour Center, Tech Completion Rep, Jan 1968. 4 p. OWRR Project A-014-Cal.

Descriptors: Water rights, *Municipal water, Water delivery, Water management, Water resources, Water sources, *Policy matters, Ground water, *Water policy, Water management (Applied), Water districts, Water development.

The objective was to examine the role of municipalities as water-policy determining entities in 4 southern California counties having a metropolitan-wide district organized to import water, supplementing local sources. Seven cities were studied with differing history in water development and service. Metropolitan-wide districts decided to not admit individual cities but rather large blocks of land which included groups of cities and unincorporated territory. The question was the effect of this decision on the municipalities role as water distributors. Of cities organized before the 1930 decision, 80% have municipal water systems; only 18% incorporated after 1930 have municipal systems. The balance are served by private water enterprises, county water districts and other types of suppliers. The second question concerned whether the policies of those cities with municipal systems were developed as political or administrative processes. Very striking differences were found between cities, depending upon background policy and character of policy.
W69-01003

STRATEGY AND ORGANIZATION IN PUBLIC LAND POLICY,
RAND Corp., Santa Monica, Calif.
George R. Hall.
Natural Resources Journal, Vol 7, No 2, pp 162-182, April 1967.

Descriptors: *Public lands, *Natural resources, *Federal Project policy, *Land management, Administration, Constraints, Geographical regions.
Identifiers: Public Land Law Review Commission, *Externalities, Exclusionary uses, Heterogeneity of land holdings, *Goods.

Significant managerial and policy improvements in the natural resources sector will require a significant reorganization of federal departments and agencies. This paper considers the strategic objectives of public land and management and the factors that make achieving these objectives a complex and difficult task. Four complicating factors are examined: externalities, exclusionary land use, heterogeneity of public land holdings and divided governmental responsibility. The last is identified as the most important barrier in the way of achieving major improvements in public policy towards natural resources. Two reforms are needed. The first is an end-use approach to policy formulation. The second and related reform is a reorganization of the administration of the federal government's natural resource responsibilities. (Seneca-Rutgers)
W69-01101

DIGEST OF WATER POLLUTION CONTROL LEGISLATION, DELAWARE.

Fed Water Pollut Contr Admin, July 1966. 4 p.

Descriptors: *Delaware, *Water pollution control, *Legislation, Water law, Delaware River Basin Commission.

This digest contains a brief outline of the laws and the organization and duties of the State agency empowered to carry out the anti-pollution water laws. Where State law provides for stream classification this has been set out together with a list of waterways or waters which have been classified by the particular legislature, the year it was done, and the classification.
W69-01121

WATER AND RELATED LAND RESOURCES LAW AND POLITICAL INSTITUTIONS.
Cornell Univ, Ithaca, N Y.
William H. Farnham.
Tech Rep 8, Water Resour Center, Nov 1967. 55 p, 95 ref. OWRR Project A-003-NY.

Descriptors: Boundaries (Property), *Riparian rights, Properties, Legal aspects, Administration, *Water law, *Water rights, *New York, Legislation, Administrative decisions, State government.

One function of social science research is to provide an understanding of social processes and justifications to allow their modification, improvement, and adjustment to new conditions. This project is one more step in modernizing the water law of the east, particularly New York state's version of Riparian Doctrine. Each step is conditioned by an overall strategy to remove uncertainty in the law without undue loss of flexibility. Further, strategy rejects as either feasible, desirable, or politically possible any major shift in water law doctrine. Instead it accepts the notion that through a review of carefully studied, well understood steps, a sounder foundation for the future can be built. Two significant changes in statute law have been proposed. The first clarified the law with respect to the legality of alterations in the natural condition of water courses and lakes which cause no harm to others, declaring them lawful and avoiding the necessity for suit by others to protect their rights until actually harmed. The second suggests that harmful alterations be lawful if reasonable and provides some guidelines for reasonableness. These changes, when adopted, will provide a clear base from which further changes can be made.
W69-01135

FIRST ANNUAL SOUTH CAROLINA GOVERNOR'S CONFERENCE ON WATER RESOURCES.
Clemson Univ., South Carolina.

Water Resour Res Inst, Mar 1967. 85 p, 1 tab. OWRR Project A-999-SC.

Descriptors: *Water resources, *Water resources development, Water quality, Water pollution, Waste treatment, Water law, Planning, Water management (Applied), Water Resources Research Act, *South Carolina, Responsibilities, Water pollution control, Hydroelectric power, Long-term planning, Conferences, Water utilization.
Identifiers: Water plans, Water use.

The First Annual South Carolina Governor's Conference on Water Resources held March 1 and 2, 1967, at Columbia, South Carolina, was for the primary purpose of: (1) exploring the current water situation in South Carolina and its relation to the national picture; (2) establishing the State's responsibilities in all aspects of Federal-State cooperation in water resources; and (3) considering programs in water resources planning and development for South Carolina. Ten papers relative to these 3 catagories were presented and are published in the Conference proceedings.
W69-01142

6F. Nonstructural Alternatives

FLOOD CONTROL VIA THE POLICE POWER,
Allison Dunham.
U Pa L Rev, Vol 107, No 8, pp 1098-1132, June 1959. 35 p, 128 ref.

Descriptors: *Flood plain zoning, Regulation, *Flood protection, Flood control, State governments, Flood plain insurance, Land use, *Flood damage, Federal government, Federal-state water rights conflicts, Legislation, Legal aspects, Project purposes, Dams, Building codes, Economic justification, Risks, Government finance.

Despite extensive study and agitation concerning water resources, public expenditure on water problems, and federal-state relations involving water, very little change in policy has occurred in the past ten years. It is the purpose of this paper to examine briefly the history of the movement toward regulation of land use in the flood plain; to suggest a conceptual framework by which the consequences of such regulation may be judged; to analyze the reasons advanced for this restriction on individual decisions concerning use of private land; and, finally, to consider the constitutional basis of this proposed use of the state's police powers. Throughout this paper the term flood plain zoning is used to cover all of the types of regulation which can be used to regulate land use for the purpose of affecting flood losses. (R. Smith-Fla)
W69-00756

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A STUDY TO DETERMINE THE STATE AND COMMUNITY RESPONSIBILITIES INHERENT IN FLOOD DAMAGE PREVENTION PLANNING IN URBAN DEVELOPMENT,
Maybelle C. Fox.
Unpublished Master's Thesis, Univ. of Miss., Department of Urban and Regional Planning, University, June 1969, 87 p, 1 append, 53 ref.

Descriptors: Urbanization, Community development, *Flood control, Multiple-purpose projects, *Non-structural alternatives, Land-use, *Flood plain zoning, Pychological aspects, Government supports, Inter-agency cooperation, Dams, Reservoirs, Channel improvements, Flood forecasting, Research and development.
Identifiers: Flood plain management, Citizen participation, University of Mississippi, Public education.

The purpose of this thesis is to determine the State and community responsibilities inherent in a successful flood damage prevention planning program. The need for flood control by preventive planning in addition to corrective measures was determined as a result of investigations conducted during the study. The major types and methods of flood control were identified, together with an analysis of their use. On the basis of the identification of these methods, the various levels of government can develop a suitable program of flood damage prevention. The importance of intergovernmental coordination and responsibility in plan formulation and implementation was stressed. Cited are examples of laws, ordinances, and regulations that have been used in flood plain management. Recommendations made are: (1) studies to determine the potential flood hazard; (2) structural methods of flood control alone are not adequate protection from flooding; (3) local citizen acceptance and participation in the program; (4) analysis of corrective and preventive measures for each locality; and, (5) where necessary, the local government should seek assistance from the State and Federal governments. (Gargola-Chicago)
W69-00946

AN ECONOMIC APPROACH TO COPING WITH FLOOD DAMAGE,
Resource for the Future, Inc., Washington, D. C.
John V. Krutilla.
Water Resources Research, Vol 2, No 2, pp 183-190, Second Quarter 1966. 2 ref.

Descriptors: *Flood damage, *Flood plain insurance, *Flood protection, Insurance, Efficiencies, Flood plains, Flood control, Cost sharing, Benefits, Costs.
Identifiers: *Insurance premiums, Public good, Residual damage potential, Compulsory flood insurance, Social cost, Private cost.

A compulsory flood loss insurance scheme is one means of achieving efficient uses of flood plain lands. Insurance premiums proportional to risk and equal to both the private and the social cost of flood plain occupance will serve as a rationing device, eliminating economically unwarranted uses of flood plain lands on the one hand, while not prohibiting uses for which a flood plain location has merit. In addition, reduction of flood loss insurance premiums can serve as a standard to measure economic justification of alternative flood control measures and/or discrete increments in the scale of protective works or other nonstructural flood control measures. A final advantage of flood loss insurance, which no alternative of flood management possesses, is indemnification for the residual damage potential against which it is not economic to seek protection. (Seneca-Rutgers)
W69-01090

6G. Ecologic Impact of Water Development

AN INVENTORY AND STUDY OF BEAVER IMPOUNDED WATER IN MISSISSIPPI,
Mississippi State Univ., State College.
Dale H. Arner, James Baker, and David Wesley.
Water Resour Res Inst Rep, July 1966. 26 p, 8 fig, 10 tab, 6 ref. OWRR Project A-009-Miss.

Descriptors: *Beavers, *Pond, *Waterfowl, Aquatic life, Ducks (Wild), Weed control, Invertebrates, Wildlife, Wildlife management, Conservation, *Impoundments, Mississippi.

A cooperative program was inaugurated with Federal and state conservation agencies to inventory beaver ponds and acreage contained in these impoundments in the state of Mississippi. Cooperating agencies reports revealed a total of 956 beaver ponds of 1 acre and over and a total of 23,673 acres flooded by beaver ponds. Research workers checked 10% of the ponds to determine accuracy of acreage estimates made by cooperating agencies and to determine acreage suitable for developing into waterfowl feeding areas. This revealed a statistically significant correlation between estimates made by cooperating agencies and measurements made by investigators. In the beaver ponds studies, 58.1% contained areas which could be planted to duck millet. It was estimated that with emergent weed control 56.5% of the total acreage of these ponds could be developed into duck feeding areas. In the Loess area invertebrates taken by all 3 techniques were in significantly greater abundance in beaver ponds than in upstream sites. In Upper Coastal Plains soils area, the weight or volume of captured invertebrates was greater in beaver ponds than in upstream sites, but was significantly greater only using the net sweeping technique.
W69-00730

CITY OF ATLANTA V WILLIAMS (SURFACE DRAINAGE).
218 Ga 379; 128 S E 2d 41-43 (1962).

Descriptors: *Drainage, *Ditches, Surface waters, Easements, *Overflow, Riparian rights, Drainage water, Water law, Legal aspects.

The plaintiff sought to enjoin the city from using its drainage ditch near his property in such a manner that surface waters overflowed onto his property. The court held that the city had, by a use of the ditch for 20 years, acquired an easement by prescription but there had been no continuous overflow of water from the ditch and the city did not have an easement to overflow the ditch. The city was under a duty to maintain the ditch so that the content and flow of surface waters would not overflow. (Horner-Fla)
W69-00825

07. RESOURCES DATA

7A. Network Design

THE MOVEMENT OF RADIONUCLIDES THROUGH SOIL FORMATIONS,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-00708

OPTIMUM DENSITY OF RAINFALL NETWORKS,
Massachusetts Institute of Technology, Cambridge. Dept of Civil Engineering.
P. S. Eagleson.
Water Resources Res, Vol 3, No 4, pp 1021-1033, 1967. 13 p, 10 fig, 12 ref.

Descriptors: *Statistical methods, *Network design, *Climatic data, *Rainfall, Rainfall disposition, Fourier analysis, Linear programming, Hydrography, Distribution patterns.
Identifiers: Network density.

Techniques of harmonic analysis and the concepts of distributed linear systems are used to study the sensitivity of peak catchment discharge to the characteristic spatial variability of convective and cyclonic storm rainfall. Application of the sampling theorem leads to quantitative general relations for optimum rainfall network density for the study of long-term, catchment-average rainfall is accomplished by considering the long-term point rainfall as a homogeneous random variable to be sampled spatially. Incorporation of catchment dynamics into the design of flood forecasting networks reduces the number of gages needed when compared with that obtained solely through consideration of precipitation variability. In many studies little advantage is gained by utilizing more than 2 properly located stations for the determination of long-term areal mean rainfall. (Author)
W69-01046

7B. Data Acquisition

ESTIMATION OF GROUND-WATER CONFIGURATION NEAR PAHALA, HAWAII USING ELECTRICAL RESISTIVITY TECHNIQUES,
Hawaii Univ., Honolulu.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00710

EFFECTS OF INDUCED STREAMBED INFILTRATION ON WATER LEVELS IN WELLS DURING AQUIFER TESTS,
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-00723

INFLUENCE OF TURBULENCE ON SURFACE REAERATION,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 05F.
For abstract, see .
W69-00728

THE CONTINUOUS PLANKTON RECORDER-A REVIEW OF THE LITERATURE,
Minnesota Univ., Minneapolis.
Theodore A. Olson, Theron O. Odlaug, and Wayland R. Swain.
Water Resour Res Center Bull 3, June 1966. 221 p 92 fig, 6 plate, 21 tab, 40 ref. OWRR Project A 011-Minn.

Descriptors: Deep water, Limnology, Atlanti Ocean, Eddies, Ocean currents, Indicators, Or ganic matter, Aquatic environment, Zooplanton Aquatic life, Aquatic populations, Biology Eutrophication, Lakes, *Productivity, Trophi level, *Plankton, *Research equipment, Biomass Plytoplankton.

The literature concerning the Continuous Plankto Recorder (CPR) is reviewed in this report. Th Hardy Recorder can be towed behind a comme cial vessel proceeding at normal speed. Organism of the plankton assemblage are swept into th mouth of the sampler and then are carried back t a point where a slowly moving bolting cloth ban crosses the water tunnel. The band, which forms complete barrier at this point and is supported the back by a coarse grid, strains out the organism Later, in the laboratory, the bands can be unrolle on a special stage and examined under microscope. Since the towing path and speed a known and the rate of tape advance within the sam pler is also known, specific portions of the boltin cloth surface can be associated with definite lak areas and a mile-by-mile estimation of the n plankton distribution is possible. The use of th recorder has been limited almost entirely to th marine environment but the same technique shou be readily applicable to studies of the organism comprising the second trophic leval in fresh water
W69-00740

A PROPOSAL TO STUDY HYDROLOGICAL DATA ACQUISITION THROUGH REMOTE RECONNAISSANCE SYSTEMS,
Montana Univ., Missoula.
Fred L. Gerlach.
Water Resour Res Center Rept, 1966. 10 p, 7 fig, 2 ref. OWRR Project B-002-Mont.

Descriptors: *Hydrologic data, Data collections, Hydrology, Surfaces, Moisture content, *Remote sensing, *Infrared radiation, *Soil moisture, Thermal radiation, Aerial photography.
Identifiers: *Infrared imagery, Infrared scanning, Aerial reconnaissance.

Areas considered by the pilot study of 1965-66 were: (1) characteristic surface temperature and surface radiation differences of selected terrain features (those having surface moisture differences). (2) Characteristic tonal contrasts on aerial infrared scanned imagery with proper consideration for other identifying characteristics in the interpretation of this imagery produced by temperature and radiation differences between features. (3) Increased probability for correct interpretation by increasing differences registered in the imagery through selection of optimum conditions or time for collecting the imagery. It is apparent from data that the time of day relative to the amount of insolation receipt is highly important. Also, weather conditions existing prior to and during the data collection characteristics of surface moisture conditions. Other work included: (1) laboratory tests of surface temperature; (2) airborne radiometric surface temperature measurements; and (3) the establishment of a series of plots for airborne radiometric temperature measurement. The objectives of this study have been partially reached. Continued study is necessary to provide a base for a broader and more intensive application of remote reconnaissance methods to water resources management and research.
W69-00742

RESPONSE OF FLOAT TYPE STAGE RECORDER SYSTEMS,
Purdue University, Lafayette, Indiana.
J. W. Delleur, and D. Blank.
Purdue Univ Eng Reprints CE 241, pp 165-172, Feb 1968. 8 p, 5 fig, OWRR Project A-001-Ind.

Descriptors: *Instrumentation, *Research and development, *Water levels, *Floats, *Gages, Stream gages, Depth.
Identifiers: *Stage recorders.

To aid in evaluating performance of hydrologic systems by measuring water yield, the frequency response and phase distortion of the measuring equipment were studied. A float type stage recorder was installed above an oscillating tank used for generating the water level fluctuations. The tank can be subjected to a vertical harmonic motion with amplitudes ranging from 4 to 10 in. and frequencies 2 to 15 cycles per minute. The dynamic equations of motion of the float are developed with and without taking into account the influence of the friction forces. The motion of the water surface as recorded by a sonic transducer was compared with the motion of the float as obtained from the stage recorder. The results indicate that the float follows the motion of the surface of the water very closely, and that, within the amplitude and frequency range tested, there is no significant signal deformation. (Knapp-USGS)
W69-00919

EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
Clemson University, Clemson, S C. Agricultural Engineering Department.
For primary bibliographic entry see Field 02G.
For abstract, see .
W69-00936

ATOMIC FLUORESCENCE FLAME SPECTROMETRY,
New Hampshire University, Durham.
David W. Ellis, and Donald R. Demers.
Advances in Chem Ser, No 73, pp 326-336, 1968. 11 p, 4 fig, 3 tab, 22 ref. OWRR Project A-003-NH.

Descriptors: *Chemical analysis, *Flame photometry, *Fluorometry, Inorganic compounds, Instrumentation, Water analysis.
Identifiers: Atomic fluorescence flame spectrometry.

The use of atomic fluorescence flame spectrometry in the analysis of trace inorganics is reviewed and evaluated. The method is competitive with and often superior to atomic absorption and flame emission methods. Its advantages are that intensity of response may be controlled, light source emission profile may be wider than the absorption profile of the sample, the response signal is added to background and may be electronically amplified, and calibration curves are linear over a wide sample concentration range. With a line source, the method is more sensitive than other flame methods. With a continuous source, both qualitative and quantitative analyses may be made simultaneously. (Knapp-USGS)
W69-00940

INSTRUMENTATION FOR SEISMIC EXPLORATION FOR GROUND WATER IN HAWAII,
Hawaii Univ., Honolulu.
Leonard A. Palmer.
Tech Rep 7, Water Resour Res Center, Apr 1967. 26 p, 12 fig, 5 ref. OWRR Project A-009-Hi.

Descriptors: *Instrumentation, *Groundwater, *Exploration, Seismic studies, Seismology, Explosions, *Hawaii, Water table.

This study developed instrumentation and techniques to be used for seismic exploration of ground water in Hawaii. A 3-stage field test of instruments and methods was conducted to determine capability of recording and reproducing seismic data. Reproducibility was the main criterion to permit using certain signal analysis techniques. Multi-channel explosive tests utilizing dynamite shots were carried out in Waimanalo, Oahu during first stage of testing. The second stage used a 2-channel magnetic tape recorder converted to receive voice and uphold geophone signals on 1 channel and seismic signals on the other channel. Stage 3 tested the use of a 'thumper' acoustical source, seismic filters, and timers developed for the project. Signals generated by explosives and recorded photographically were very reproducible, but this is relatively expensive and analysis is slow. Seismic data recorded on magnetic tape allows versatility in analysis of recorded signals reproduced either in wiggle or intensity contrast analog form. Sections can be selected for digital computer analysis. The findings from this pilot phase do not indicate that seismology would not be an appropriate tool for studying geological structure.
W69-00974

PILOT EVAPOTRANSPIRATION STUDY: LYSIMETER DESIGN,
Hawaii Univ., Manoa.
For primary bibliographic entry see Field 02D.
For abstract, see .
W69-00981

REMOTE SENSING OF HAWAIIAN COASTAL SPRINGS USING MULTISPECTRAL AND INFRARED TECHNIQUES,
Hawaii Univ., Manoa.
Larry K. Lepley, and Leonard A. Palmer.
Tech Rep 18, Water Resour Res Center, Aug 1967. 39 p, 16 fig, 3 tab, 31 ref. OWRR Project B-005-Hi.

Descriptors: *Remote sensing, Water resources, Aerial photography, Temperature, Thermometers, *Springs, Synoptic analysis, Photography, Spectophotometry, Color, Hydrology, Sea water, Fresh water, Coasts.
Identifiers: Radiometers, Infrared imagery, Infrared spectroscopy.

Two remote sensing techniques for measuring offshore ground-water spring discharge have been studied: (1) multispectral photography, and (2) infrared thermometry. During the summer of 1967, exposure factors for filter-film-camera combinations extending outside the visible spectra were experimentally determined and tabulated. One spectral series of simulated aerial photography was obtained. Darkroom procedures and equipment for multispectral enhancement of the suspected color differences between sea water and offshore spring water in these photographs have not yet been precisely defined. Helicopter flights with an infrared thermometer have demonstrated that offshore springs can be identified by their temperatures. Due to the irregular shape, size, and location of these fresh water outflows, a synoptic technique is needed. An infrared scanner is desirable but the present costs are prohibitive.
W69-00982

SOME SEISMIC TECHNIQUES FOR MAPPING SMALL SCALE SHALLOW STRUCTURES,
Hawaii Univ., Manoa.
Cornelius Joziasse, and William M. Adams.
Tech Rep 11, Water Resour Res Center, Aug 1967. 15 p, 10 fig, 4 ref. OWRR Project B-005-Hi.

Descriptors: Hawaii, Microwaves, Seismic waves, Seismic studies, Vibrations, Mapping, Geologic mapping, Surveys, Geophysics, *Seismic investigations, *Seismographs, Subsurface investigations, Exploration, Instrumentation.
Identifiers: Reflectivity, Seismic tests, Oahu, Hawaii, Seismic refraction, Seismic reflection.

Seismic recording and playback techniques and equipment are being developed for use in mapping small-scale geologic structures of significance in controlling movement of ground water. High-frequency seismic waves produced by weight-dropping, or thumping, are used to provide the necessary resolution to detect these small structures. A vibrator has been constructed as another source of high frequency seismic energy. A DC motor is the transducer with storage batteries providing the power. A 4-channel tape recorder is used to obtain seismic records on a 10-ft spacing. This spacing gives good correlation from record to record. A storage oscilloscope gives visual displays of seismic data as wiggly line playbacks which are stored on the screen and then photographed. Also being used is variable intensity playback of reflection records. This allows signal averaging to be done optically and gives an easily interpreted display. A seismic survey done in the Waimanalo area on Oahu, Hawaii indicates that the thumper can produce sufficient amounts of high frequency energy to permit shallow reflection prospecting.
W69-00985

SEDIMENT SAMPLING: INSTRUMENTATION AND TECHNIQUES,
Dept. of Agriculture, Oxford, Miss., Sedimentation Laboratory.
C. R. Miller, and A. J. Bowie.
Trans. Amer Soc Agr Eng, Vol 8, No 2, pp 267-270,274, 1965.

Descriptors: *Bed load, Sediment load, *Sediment transport, *Sediment discharge, *Sampling, *Instrumentation, Arid lands, Data collections, Measurement, Streams, Technology, Research and development, Mechanical equipment.

The various instruments and techniques currently employed by the U.S.D.A. Sedimentation Laboratory to sample sediment discharge were described. Major problems associated with accurate determination of total sediment movement and measurement of sediment discharge on rapid rising streams and at remote locations were discussed. A variety

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of methods to improve and automate sediment sampling that are under investigation by the Federal Inter-Agency Sedimentation Project were described. Continuing research will provide guides and methods for combining field sediment-sampling results with stream hydraulics and sediment characteristics in the development of methodology for determining total sediment discharge that occurs in streams that are located in the arid parts of the world. (Blecker-Ariz)
W69-01015

A TECHNIQUE TO DETERMINE EVAPORATION FROM DRY STREAM BEDS,
Ariz. Univ., Tucson. Institute of Atmospheric Physics.
For primary bibliographic entry see Field 02D.
For abstract, see .
W69-01026

RADAR ESTIMATION OF RAINFALL,
New Zealand Meteorological Service, Wellington.
For primary bibliographic entry see Field 02B.
For abstract, see .
W69-01029

ON THE COMPARISON OF PRECIPITATION GAUGES,
India Meteorological Office, Poona.
V. Kalyanasundaram.
Indian J Meteorol Geophys, Vol 17, No 4, pp 627-632, October 1966. 6 p, 3 fig, 3 tab.

Descriptors: *Precipitation gages, *Arid climates, Measurement, *Reliability, *Rain gages, Instrumentation, Data collections, Variability.
Identifiers: *Comparisons, India.

Reliability of rainfall measurements made in India were assessed using comparisons between raingauges in routine use in the national network and raingauges adopted by W.M.O. as International Reference Precipitation Gauges (IRPG). Differences between the 24-hour rainfalls recorded by two I.M.D. gauges varied between 0.4 and 1% while differences between two IRPG's were smaller and insignificant. All differences were insignificant above a daily rainfall of 25mm. Descriptions of the various raingauges and details of their installation were given. In order to determine and compare hydrologic factors that occur on different arid watersheds of the world, raingauges used in these areas must be correlated in order to receive valid information from these different localities. (Blecker-Ariz)
W69-01030

IMPROVEMENT AND TEST OF AN INSTRUMENT FOR RECORDING COARSE SEDIMENTS,
N. Ya. Solov'yev.
Soviet Hydrol: Selec Pap, No 2, pp 158-172, 1967. 15 p, 9 fig, 2 tab, 6 ref. Translation from Trudy GGI, No 141, pp 58-78, 1967.

Descriptors: *Instrumentation, *Sediment discharge, *Saltation, Streams, Flumes.
Identifiers: USSR, Coarse sediment sensor.

An instrument for detecting coarse sediment particles moving above stream beds is described. The principle of operation is the impact of particles on a plate connected to the moving part of an induction transducer. The signal produced is proportional to the product of mass and velocity of the particle. Because the instrument changes the pattern of flow locally so that particle velocity on impact with the receiving plate is not the same as in the undisturbed stream calibration experiments were made in a flume in a mountain stream. Data from the sensor are recorded by a five channel pulse height analyzer. Field tests show that the response of the sensor to fluctuating sediment discharge is more accurate than the results of standard determinations by sampling. (Knapp-USGS)
W69-01041

A SENSOR FOR WATER FLUX IN SOIL. 'POINT SOURCE' INSTRUMENT,
Commonwealth Scientific and Industrial Research Organization. Div. of Land Research, Canberra (Australia).
G. F. Byrne, J. E. Drummond, and C. W. Rose.
Water Resources Res, Vol 3, No 4, pp 1073-1078, 1967. 6 p, 2 fig, 10 ref.

Descriptors: *Groundwater movement, *Instrumentation, *On-site tests, *Current meters, *Flowmeters, Calibrations, Research and development.
Identifiers: Soil water flux meters.

The theoretical analysis and laboratory calibration of a sensor to measure fluid in soil or other porous medium shows that a flow velocity of .0001 cm per sec can be readily measured, and that output is uniquily related to flux. The flow to be measured causes asymmetry in the temperature field generated by an approximation to a point source of heat located centrally in the instrument. The temperature difference due to this asymmetry gives rise to the output of the instrument. The instrument was tested and calibrated in a saturated clay loam. The sensitivity is such that there is some promise that the instrument may be of utility in flux measurement in unsaturated as well as saturated media. (Author)
W69-01050

A STUDY OF GROUND-WATER CONTAMINATION DUE TO OIL-FIELD BRINES IN MORROW AND DELAWARE COUNTIES, OHIO, WITH EMPHASIS ON DETECTION UTILIZING ELECTRICAL RESISTIVITY TECHNIQUES,
Ohio State Univ., Columbus.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01119

7C. Evaluation, Processing AND Publication

WATER RESOURCE OBSERVATORY CLIMATOLOGICAL DATA WATER YEAR 1966 AND PRIOR.
Wyoming Univ., Laramie.
For primary bibliographic entry see Field 02B.
For abstract, see .
W69-00978

AUTOMATIC PROCESSING OF OPERATIONAL HYDROLOGIC INFORMATION,
Hydrometeorological Sciences Research Center, USSR.
Ye. P. Chemerenko.
Soviet Hydrol: Selec Pap, No 2, pp 189-194, 1967. 6 p, 1 fig. Translation from Trudy GMTs No 2, pp 59-66, 1967.

Descriptors: *Data processing, *Computers, Data transmission, Networks, Telemetry, Statistical methods, Numerical analysis.
Identifiers: USSR, Hydrological data network, Automatic data handling.

Some problems associated with automation of the processing of hydrologic information received at the USSR Hydrometeorological Scientific Research Center are examined. Variants of programs for recoding, storing, and searching and preparing the needed parameters for computation are described. At present practically all hydrologic information is processed by hand. Numerical methods of forecasting are nearly never used in operational work. Most of the forecasting methods are based on the use of relatively simple empirical relationships which have insufficient reliability and accuracy, so an important role is played by the experience and intuition of the forecaster. Furthermore, at present the data input is too small for automatic processing of hydrologic data alone to be economically feasible. However, meteorological data are handled automatically and are the major part of the work at the hydrometeorological center. Hydrological data can be included at very little additional cost when appropriate methods of analysis are developed. Current studies in the use of computers in handling hydrologic data include multidimensional statistical analysis and numerical methods for solving differential equations. (Knapp-USGS)
W69-01032

SOLUTION OF INVERSE PROBLEMS FOR LINEAR FLOW MODELS,
Hydrometeorological Sciences Research Center, USSR.
L. S. Kuchment.
Soviet Hydrol: Selec Pap, No 2 pp 194-199, 1967. 6 p, 3 fig, 10 ref. Translation from Meteorologiya i gidrologiya, No 4, pp 73-79, 1967.

Descriptors: *Linear programming, *Mathematical models, *Hydrographs, *Routing, Inflow, Discharge (Water), Computers, Optimization.
Identifiers: USSR.

A linear mathematical model for computing flow hydrographs is discussed. It is also possible to use the model inversely to find input using the outflow hydrograph and the given functional relation, and the functional relation may be found given inflow and outflow. Instabilities in the solutions are avoided by use of the theory of incorrect problems, based on a method of best approximation. (Knapp-USGS)
W69-01034

A METHOD OF DETERMINING THE PERMEABILITY AND EFFECTIVE POROSITY OF UNCONFINED ANISOTROPIC AQUIFERS,
Technion Israel Institute of Technology, Haifa.
G. Dagan.
Water Resources Res, Vol 3, No 4, pp 1059-1071, 1967. 13 p, 8 fig, 1 tab, 16 ref.

Descriptors: *Groundwater movement, *Drawdown, *Unsteady flow, *Aquifer characteristics, *Anisotropy, Thesis equation, Permeability, Porosity, Transmissivity.
Identifiers: Anisotropic aquifers.

The equations of unsteady flow toward a partially penetrating well in an unconfined aquifer of finite thickness are solved by linearization. It is assumed that the aquifer is nondeformable and the effective porosity at the water table is constant. It is also assumed that the aquifer is anisotropic (the principal axes of the permeability tensor being horizontal and vertical, respectively), that the pumping discharge is constant, and that the drawdowns are small. The vertical component of the flow velocity is not neglected. The solution is therefore, equally valid in the vicinity and at large distances from the pumping well. In the latter case, it coincides with the Thesis solution. A method of matching the theoretical solution with drawdown measurements during pumping tests is outlined. By the matching method the horizontal and vertical hydraulic conductivities and the effective porosity of the aquifer may be determined. The method is illustrated by analyzing data from pumping tests carried out in three anisotropic aquifers. (Author)
W69-01044

ANALYSIS OF NON LINEARITIES IN GROUNDWATER HYDROLOGY: A HYBRID COMPUTER APPROACH,
California Univ., Los Angeles.
Venkateswararao Vermuri, and John A. Dracup.
Water Resources Res, Vol 3, No 4, pp 1047-1057, 1967. 12 p, 8 fig, 14 ref.

Descriptors: *Groundwater movement, *Equations, *Digital computers, *Analog computers, Model studies, Hydrology.
Identifiers: Navier-Stokes Equations, Hybrid computers.

A hybrid computer method to solve nonlinear partial differential equations describing the flow of fluids in underground formations is described. Using finite difference methods, the problems are first programmed by a flow chart for a pure digital computer solution. Because the ability of resistance networks to solve a set of simultaneous equations instantaneously is recognized, major matrix inversion subroutines in the digital flow chart are replaced by analog resistance network hardware. Incorporation of analog hardware drastically reduces the computation time involved in inversion of large matrices. The resistance network constructed on an analog computer patch board allows an unparalleled flexibility not available in a digital computer. (Author)
W69-01047

SCHEMES FOR HANDLING INCONSISTENT MATRICES.
Harvard Univ, Cambridge, Massachusetts.
Myron B. Fiering.
Water Resources Research, Vol 4, No 2, pp 291-297, April 1968. 2 append.

Descriptors: *Statistical methods, Correlation analysis, Efficiencies, Monte Carlo method.
Identifiers: *Inconsistent matrices, *Multivariate analysis, Algorithms, Eigenvalue, Consistency, Linear transformation.

The increasing role of multivariate statistical techniques, a trend based on the growing availability of computers and on pressures for streamlined representation of multidimensional arrays of data, carries with it the responsibility for using efficient methods to manipulate matrices and arrays. It frequently happens that all records in a multivariate system (of flow records, quality measurements, or whatever) are not equally long, and that some subsets of these records do not present a consistent pattern of correlation when the entire bivariate correlation matrix is reconstructed. If one or more estimate is such that the entire correlation matrix is rendered inconsistent, repairs must be effected before continuing the multivariate analysis. Two algorithms for systematically finding a set of adjustments that satisfy the requirements of consistency are given, however, the results are not unique. (Seneca-Rutgers)
W69-01063

STATUS EVALUATION OF SURFACE WATERS IN TEXAS.
Texas Agricultural and Mechanical Univ, College Station.
William J. Clark.
Rep, Biology Dept, 1966. 102 p, 6 tab, 296 ref, 2 append. OWRR Project A-005-Tex.

Descriptors: *Texas, Publications, *Bibliographies, *Personnel, Fish, Organizations, Limnology, Aquatic microbiology, Inland waterways, *Surface waters, Evaluation, Reviews.

Data have been gathered concerning publications, personnel, and government organizations related to the limnology, aquatic biology and ichthyology of the inland waters of Texas. A total of 289 citations of published papers, dissertations and thesis have been found and organized by a computer program into a Keyword in Context (KWIC) index and an alphabetical bibliography. Reports of the Texas Parks and Wildlife Department containing pertinent information are indexed in an alphabetical table by name of the body of water studied. A partial list of taxonomic papers from bordering states is included as an appendix. Addresses, names of pertinent officers and personnel, and a brief description of duties and jurisdictions, are listed for 17 state and federal agencies. Course titles and instructors names are listed for pertinent courses at 13 colleges and universities in the state.
W69-01116

A STORAGE AND RETRIEVAL SYSTEM FOR THE NEVADA WATER RESOURCES DATA CENTER.
Nevada Univ, Reno.
L. Crouse, and G. B. Maxey.
Water Resour Res Center, Proj Rep 5, Desert Res Inst, Feb 1967. 13 p, 2 ref. OWRR Project A-010-Nev.

Descriptors: *Data storage and retrieval, Computer programs, Data processing, Data transmission, *Information retrieval, Data collections, Nevada, *Water resources, Water resources development.

The objective of the data center is to provide an information storage and retrieval system to facilitate water resource research. Because data is widely scattered in the files of different government and other agencies, items are not in standard format, and calculations often have to be made by hand, or, if a computer program is used, has to be coded by key punching, and the time and expense these problems incur, much water resource data which could be used is not. The data center alleviates these problems by providing uniform data formats, efficient storage, rapid retrieval and the integration of routine calculations into the main storage and retrieval program. The center collects and formats incoming water resource data then processes, stores and retrieves it on a computer system. It allows the researcher to have quick access to information in standard formats, with routine calculations automatically made for him, and enables him to easily and quickly call for sort and up-date operations. The progress of the Nevada Water Resources Data Center to date is included. (J. Phoenix-Nevada).
W69-01118

STORAGE AND RETRIEVAL OF DATA FOR WATER QUALITY CONTROL.
Federal Water Pollution Control Administration, Washington, D C.
Richard S. Green.
Fed Water Pollut Contr Admin, Aug 1966. 36 p, 13 fig, 4 tab, 2 ref, 3 append.

Descriptors: Water quality control, Information retrieval, *Data storage and retrieval, Data collections, Computer programs, Hydrologic data, *Water quality.
Identifiers: *Water quality data, *STORET.

This system for the storage and retrieval of data for water quality control was developed from ideas brought together in a brief informal conference held in the Basic Data Branch, Division of Water Supply and Pollution Control, U.S. Public Health Service, in August 1961. In this publication the following information is presented: (1) The current water quality control data handling situation, (2) Scope of the system, (3) The system design, (4) Storage procedure, (5) Deleting and changing data, (6) Use of data from other systems, (7) Retrieval routine.
W69-01126

INVENTORY OF PRINTED INFORMATION AND DATA PERTAINING TO WATER AND RELATED RESOURCES OF NEVADA.
Nevada Univ, Reno.
Hugh A. Shamberger.
Center Water Resour Res, 1967. 144 p, 1300 ref.

Descriptors: *Water resources, Bibliographies, Publications, Water resources development, Information retrieval, *Nevada.

This publication attempts to inventory all of printed information pertaining to Nevada's water resources together with a fairly complete listing of related resources publications. This publication is divided into 2 basic indexes: an author index and a subject index. Reports prepared for an agency but listing individual authors have been listed under the authors index as well as the agency name. Papers prepared for agencies which do not identify the author are indexed according to agency name. Listing of authors and subjects is alphabetical. When there are 2 or more coauthors, the first named is considered the senior author and the subject matter is listed under his name. The names of the coauthors are listed and referenced to the senior author. The subject index does not cover every paper in the author index but is sufficiently complete to meet most demands.
W69-01128

PERMUTED TITLE INDEX--1963.
Cornell Univ, Ithaca, N Y.

Water Resour Center, 1963. 90 p, 1298 ref. OWRR Project A-999-NY.

Descriptors: Reviews, Publications, *Water resources, Documentation, *Bibliographies, Technical writing.
Identifiers: *Current awareness.

Cornell University Water Resources Center has instituted a current awareness service in the water resources area. This service consists of a monthly list of journal articles, books, and reports randomly organized and an annual Permuted Title Index, sometimes called a KWIC (Key Word in Context) index, including the titles which have appeared in the current awareness list. This service provides a convenient and time-saving method of browsing current literature. An alphabetical list of journals regularly searched for water resource related papers is included. This list is limited to sources originally published in the English language or are regularly translated.
W69-01138

PSYCHROMETRIC TABLES FOR WYOMING,
Wyoming Univ, Laramie.
Paul A. Rechard.
Water Resour Res Inst, Aug 1967. 31 p, 10 tab. OWRR Project A-001-WYO.

Descriptors: *Psychrometrics, *Humidity, *Dew point, Barometric pressures, Meteorology, *Meteorological data, Temperature, Wyoming.

To facilitate the computation of relative humidity and dew points from sling psychrometer readings at the higher elevations experienced in Wyoming, tables of these parameters related to dry-bulb temperatures and wet-bulb depressions are presented for atmospheric pressures of 19, 21, 23, and 25 in. These pressures correspond roughly to elevations of 12,000-, 9,500-, 7,000-, and 4,800-ft MSL. The equations and data for making the computations are included.
W69-01159

08. ENGINEERING WORKS

8A. Structures

EMINENT DOMAIN: PUBLIC UTILITIES--CONSTRUCTING DAMS FOR WATER POWER.
State of Florida, Tallahassee.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00802

CONSTRUCTION PERMITS FOR DAMS, DIKES, OR LEVEES.

Ohio Laws 1967, Ch H589.

Descriptors: *Legislation, *Ohio, *Dam construction, *Permits, Dams, Dikes, Levees, Administrative agencies, Estimated costs, Engineers estimates, Inspection, Public health, Regulation, Spillways, Water levels, Impoundments, Storage capacity, Judicial decisions.
Identifiers: Attorney General, Injunction.

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No dam may be constructed for any purpose, nor shall any dike or levee be constructed for the purpose of diverting or retaining flood water, unless the chief or the chief of the division of water has issued a construction permit. Five categories exist for which such permits are not required. Before a permit may be issued, two copies of the plans and specifications, including a detailed cost estimate, for the proposed construction prepared by a registered professional engineer shall be filed with the chief. The chief shall issue or deny a permit within thirty days from the date of the recept of the application. The chief may deny a permit if he finds that a dam, dike, or levee built in accordance with the plans and specifications would endanger life, health, or property. The decision of the chief is subject to appeal. The chief or a registered professional engineer must make inspections during construction. If construction is in violation of the permit, the chief may order construction to cease. The attorney general may bring an action for an injunction to enforce an order of the chief. (Smodish-Fla)
W69-00849

INSPECTION OF PROJECT WORKS WITH RESPECT TO SAFETY OF STRUCTURES - SETTLEMENTS INVOLVING HEADWATERS - RELICENSING OF PROJECTS.

18 CFR 12.1-12.6, 13.1, 16.1-16.5 (1968).

Descriptors: *Federal Power Act, Projects, *Dams, *Inspection, Storage capacity, Settlement, Movement, Erosion, Seepage, Contracts, Stress, Hydrostatic pressure, Leakage, Administrative agencies, Regulations.
Identifiers: Federal Power Commission, *Non-federal power developers.

Dams exceeding 35 feet in height with a storage capacity of 2000 acres feet which are licensed under Part 1 of the Federal Power Act must be inspected every 5 years. This inspection is of settlement, movement, erosion, seepage, leakage, cracking, stress, and hydrostatic pressures in structures. When the inspection indicates conditions of concern, the Federal Power Commission shall cause additional inspections. Qualified independent consultants are responsible for the inspections. They must file reports and include their recommendations. The licensee is required to submit a plan of action. Contracts may be entered into by licensees and permittees having headwater improvements and downstream non-federal power developers who receive power benefits. Projects not recaptured by Congress upon the expiration of the license and projects not subject to recapture may be relicensed. The various requirements for relicensing are provided. The inspection requirements have a retroactive effect. (Childs-Fla)
W69-00881

RECTANGULAR CUTTHROAT FLOW MEASURING FLUMES,
Utah State Univ, Logan.
Gaylord V. Skogerboe, and M. Leon Hyatt.
Proc Amer Soc Civ Eng, J Irrig Drain Div, Vol 93, IR4, Pap 5628, pp 1-13, 1967. 13 p, 9 fig, 1 tab, 7 ref, append. OWRR Project B-006-UTAH.

Descriptors: *Discharge measurement, *Water measurement, *Flumes, Measuring instruments, Hydraulics, Installation, Maintenance, Laboratory tests, Subcritical flow, Open channel flow, Hydraulic structures, Design criteria, Submergence, Discharge coefficients.
Identifiers: *Cutthroat flumes, Submerged flow.

Rectangular cutthroat flumes have been developed, and their roles in water measurement, along with the advantages of their use, are discussed. Dimensions and criteria for constructing cutthroat flumes are given. Differences between free flow and submerged flow conditions are examined, along with the necessary criteria for determining which flow regime exists. The value of the transition submergence is listed for each of the rectangular cutthroat flumes investigated. The free flow analysis and tables are presented for the cutthroat flumes studied, as are the 3-dimensional calibration curves used when the submerged flow exists in the flumes. Examples illustrating free and submerged flow operation are included. Proper installation and maintenance procedures for cutthroat flumes are described, as well as techniques for measuring flow depth which will yield satisfactory results.
W69-01146

MEMORANDUM REPORT ON TEST DRILLING AT NORFOLK VIRGINIA,
U S Geol Surv, WRD, Richmond, Virginia.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-01175

8B. Hydraulics

ANALYSIS OF SUBMERGENCE IN FLOW MEASURING FLUMES,
Utah State Univ., Logan, Eng Dept.
Gaylord V. Skogerboe, and M. Leon Hyatt.
Tour of Hydraulics Div, Proc Amer Soc Civ Eng, Vol 93, No HY4, Pap 4348, pp 183-200, July 1967. 18 p, 15 fig, 12 ref, append. OWRR Project B-006-Utah.

Descriptors: Open channel flow, *Water measurement, Hydraulics, *Flow measurement, Hydraulic structures, *Flumes, Roughness, Critical depth, *Subcritical flow, Laboratory tests, Measuring instruments, Control structures, *Submergence, Parshall flumes.
Identifiers: *Submerged flow, Boundary conditions, Free flow, Trapezoidal flumes.

The calibration curves which describe submergence in flow-measuring flumes are developed by a combination of dimensional analysis and empiricism. The parameters developed in this manner are further verified by the theoretical submerged flow equation developed from momentum relationships. A flat-bottomed rectangular measuring flume was used to generate data necessary for establishing the parameters describing submerged flow. The resulting form of the discharge equation has been verified for a trapezoidal flat-bottomed flume and a Parshall flume. For any particular flume geometry, both the free flow and submerged flow equations can be placed on a single graph.
W69-00989

8C. Hydraulic Machinery

UNION ELEC CO V FPC (CONSTRUCTION OF POWER PLANT ON NON-NAVIGABLE STREAM).

326 F 2d 535-554 (8 Cir 1964).

Descriptors: *Federal Power Act, Missouri, *Hydroelectric project licensing, *Hydroelectric plants, Federal jurisdiction, State jurisdiction, Sluice gates, Spillway crests, River flow, Navigable waters, non-navigable waters, Hydroelectric power, Transmission (Electric), Pumped storage, Judicial decisions, Interstate rivers, Turbines.
Identifiers: Black River, Federal Power Commission.

The Federal Power Commission held that the Union Electric Company would have to procure a license for construction of a high head pumped-storage electric generating station on the East Fork of the Black River in Missouri. Power is generated by water flowing into a lower pool. The water then is pumped back into an upper reservoir for re-use. The Federal Power Act provides for said license if the Commission finds that any construction project in any non-navigable stream affects interstate or foreign commerce. The court held that the Commission ruling was an order subject to review. The Commission found that the interests of interstate commerce would be affected because the navigability of the Black River was affected. This finding and order were set aside because there was not substantial evidence to support them. Based on an 18-year record of flows the station could only adversely affect the flow one-half of 1 percent of the time and this would only occur if certain circumstances, such as malfunction, occurred. That the electricity produced would be transmitted interstate has no bearing on the licensing statute. McDermott-Fla)
W69-00852

OPTIMIZATION OF A NUCLEAR POWER PLANT BY HYBRID COMPUTER,
Electronic Associates, Inc., Princeton, N. J.
Joseph J. Kovacs.
Comput Automat, Vol 17, No 7, pp 26-31, July 1968. 6 p, 5 fig, append.

Descriptors: *Computers, Analog computers, Digital computers, Optimum use, *Computer programming, Economics, *Nuclear powerplants, Simulation, Control systems, Costs, Data collection systems, Data reduction, Systems analysis, Automation, Mathematical analysis, *Operations research, Data transmission systems, Solutions, Models, Power system operations.
Identifiers: *Analog-digital computers, Problem solving, Procedures, *Optimization, Variables.

The operation of a nuclear powerplant was studied using the Electronic Associates, Inc 8900 Hybrid Computer System. The purpose was to determine the most economical way to simulate kinetic behavior of a nuclear power station and related control system. Ordinary digital methods of calculating such a complicated control system are uneconomical and impractical because over 400 days of continuous computer time would be required. The subject of this study and the computational technique are unusual. The objectives that led to the use of a hybrid computer facility and the physical system used are described. The programming techniques that resulted in the computer model of the powerplant are outlined. The economy and fast result-yielding capability of the hybrid approach are demonstrated as follows: (1) the 10 times faster-than-real-time speed of the hybrid model gives speed advantage over the digital approach by a factor of 200; (2) the economic advantage of the hybrid over the digital approach is 400 to 1; and (3) the economic advantage of the hybrid over the pure analog approach is 50 to 1.
W69-00911

THE OPTIMIZATION OF LARGE SCALE WATER RESOURCE SYSTEMS: OPERATIONAL ASPECTS, PART 1: CONCEPTUAL FRAMEWORK,
California Univ., Los Angeles.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-00961

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

MANPOWER AND TRAINING NEEDS IN WATER POLLUTION CONTROL.

U S Congr, 90th Congr, 1st Sess, Doc 49, Au
1967. 50 p, 3 tab, 3 append.

Descriptors: *Manpower, *Training, *Water pollu
tion control, *Water quality control.

The need for trained personnel in the clean wate
field has become particularly demanding in recer
years. The construction rates of both municipal an
industrial waste treatment plants have been ac
celerated. Treatment plants have grown larger an

more complex and require more highly trained operating staffs. In recognition of this problem, the Congress has directed that a national study be made of trained manpower needs and training resources. This report has been prepared in response to this congressional directive.
W69-01124

9B. Education (In-House)

THE CHANGING ROLE OF THE FEDERAL CAREER EXECUTIVE,
Bureau of the Budget, Washington, D. C.
Roger W. Jones.
Civ Serv J, Vol 8, No 4, pp 15-20, Apr-June 1968. 6 p.

Descriptors: *Administration, History, Values, Responsibilities, *United States Government, Population, Planning, Training, Leadership, *Civil service, Psychology, Economics, Decision making, Communications, Social values, Public services, Social sciences, Manpower.
Identifiers: *Executives, *Federal agencies, State governments, Social aspects, Management planning, Cooperation, Local governments.

Federal career administrators are responsible for studying our Federal system of government to find ways to meet the needs of the people and the times, and to find means for accomplishing this within the framework of Federal and state constitutions and laws. Career managers must aid political executives in building a Federal system that is people-oriented and capable of dealing with the growing complexity and interdependence of all segments of our society. Since these problems often are not nationwide, decentralization of Federal agencies and cooperation with state and local governments, agencies, and nongovernmental entities are essential. The Federal career executive must devise coordinated and interlocking activities to solve deep-rooted social and economic problems, and become actively concerned with the politics of programs and policies without partisanship. He must relate his responsibilities to the public good by studying values and providing continuity and historical perspective to his programs. His role is to get work done, decisions made, and policies carried into effect through the management and leadership of people, ideas, and resources. He must use new technologies and advances, computer sciences, behavioral sciences, social sciences including economics, and communications.
W69-00958

9D. Grants, Contracts, AND Research Act Allotments

OFFICE OF WATER RESOURCES RESEARCH, DEPARTMENT OF THE INTERIOR.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-00775

FOURTH ANNUAL REPORT - FISCAL YEAR 1967-68.
Clemson University, Clemson, S. C.

Water Resources Research Institute, Clemson University, Fourth Annual Report Fiscal Year 1967-68, 81 p, July 1968, 17 ref.

Descriptors: *Research, *Projects, *South Carolina, *Training, *Education.

Summaries of research performed during the year 1967-68 under each of ten allotment projects and four matching grant projects are presented. Work remaining to be accomplished is included on five new allotment projects and one new matching grant project. One or more projects contribute to overall research on the nature of water, the water cycle, water quality management and protection, water resources planning and engineering works. The portion of the report on training and education gives statistics on new staff and facilities, interdisciplinary arrangements and student enrollment in water resources. Report of involvement of the Institute in public affairs is emphasized through research, sponsorship of a conference, and participation by individuals in such activities as the Governor's Advisory Committee, State Agencies, and State Boards. (Snell-Clemson)
W69-00808

ANNUAL REPORT FISCAL YEAR 1968 WATER RESEARCH INSTITUTE,
West Virginia Univ, Morgantown, Water Research Inst.
Chester L. Dodson.
Annual Repts, FY 1968, 1968, 69 p.

Descriptors: *West Virginia, *Education, Training, Water resources, Acid mine water, *Water quality, *Environmental effects, Project purposes, Small watersheds, Fisheries, Fish management, Conservation, Management, Water law, Legislation, Publications, Research and development, Runoff, Project benefits, Standards, Waste treatment, Sediments, Iron, Clays.
Identifiers: *Annual report, Education and training, Project progress, *Water research institute, *Water research, Water-quality standards.

This is a routine annual report. It reports on progress made for 17 projects: 10 biologic, 4 hydrologic, and 3 geochemical. Most of them are related to acid mine water or water quality. Biologic projects involve study of environmental effects and seeking new methods for waste treatment. Hydrologic projects include small-watershed and precipitation-distribution studies. Geochemical projects involve sediment in reservoirs and water in flooded mineshafts. Results will be used in planning water-quality standards, sports fisheries, runoff-and-precipitation analyses, and additional research. Some unpublished results are now usable. Some results will be published in FY 1969. Education and training data show a numerical relationship of this field to research. The Director and members of the Institute participate in representative public meetings to gain knowledge needed to plan research related to 'real life' conditions and to disseminate information to the meeting attendees. The Institute is working with a legislative committee studying West Virginia water-law needs. (Author)
W69-00859

ANNUAL REPORT OF ACTIVITIES FOR FISCAL YEAR 1968 WATER RESOURCES CENTER, UNIVERSITY OF MAINE,
Maine Univ, Orono, Maine.
W. Viessman, Jr.
Annual Report of Activities for Fiscal Year 1968 Water Resources Center, University of Maine, Publication No. 4, June 1968, 38 pp, 2 append, disc.

Descriptors: Water resources, Water quality, Hydrology, Soil moisture, Watershed management.
Identifiers: Water resources research, Maine water problems.

A discussion of the accomplishments of the Maine Water Resources Center for fiscal year 1968. Involvement of the Center in research, education and training, and coordination of various water resources activities is outlined. Individual research reports on continuing projects are included. (Author)
W69-00909

ANNUAL REPORT TO OFFICE OF WATER RESOURCES RESEARCH FOR FISCAL YEAR ENDING JUNE 30, 1968,
Minnesota Univ, St. Paul, Minn.
William C. Walton.
Minnesota Water Resources Research Center, Mimeographed Report, August 1968. 96 p, 3 fig, 30 tab, 10 ref.

Descriptors: *Water Resources Research, *Minnesota Water Resources Research Center, *Fiscal Year 1968 Annual Report.

The University of Minnesota established on September 1, 1964, in the Graduate School an interdisciplinary Water Resources Research Center. The Center has responsibility for unifying and stimulating University water resources research through the administration of funds associated with the Water Resources Research Act and made available by other sources and assisting in training additional scientists for work in the field of water resources through research. The Center financed 14 research projects involving 11 faculty members during Fiscal Year 1968. These research projects were concerned with pothole drainage and groundwater resources, movement of water through soils, overfertilization of lakes and streams, surface water runoff, water law in Minnesota, and water quality management. During the 1966-67 academic year, there were 35 seniors, 38 master's degree students, and 26 doctoral students using equipment and supplies purchased wholly or in part by the Center. About 45 students received employment as research assistants through the Center's program. (Author)
W69-00910

INSTITUTE OF WATER RESEARCH ANNUAL REPORT FOR 1967-1968,
Michigan State Univ, Lansing, Water Resources Research Institute.
Robert C. Ball, and Niles R. Kevern.
Annual Report for 1967-1968 of Water Resources Research Sponsored under Public Law 88-379 in Michigan, 1968.

Descriptors: Allotments, Training, Farm ponds, Hydrogeology, Geologic mapping, Glaciers, Pesticide residues, Tertiary treatment, Adsorption, Limnology, Forest soils, Soil disposal fields, Nitrates, Phosphates, Watershed management.
Identifiers: Michigan.

The report includes brief descriptions of eleven allotment grant projects and three matching grant projects funded under Public Law 88-379. There were five allotment projects in engineering on waste water handling and treatment, four in biology on limnological aspects of pollution, one in geology on groundwater, and one in hydrology concerned with properties of forest soils. All matching grants were in geology, one on glaciology and two on groundwater research. The Institute in Michigan advised on the development of two new watershed councils, cooperated with an existing council on stream monitoring, and served in an advisory capacity to State and Federal agencies on topics of water quality standards, pesticide problems, pollution, and water resources research programs. Interest in water resources research was stimulated through seminars, development of new courses, and meetings of Campus research leaders. The report includes a summary of the scope of college training of water resources majors at four Michigan universities. (Kevern-Mich State)
W69-00960

ANNUAL PROGRAM REPORT, FISCAL YEAR 1968 PUBLICATION AUGUST 15, 1968,
Missouri Univ, Columbia, Missouri Water Resources Research Center.
George E. Smith.
Water Resources Research Center.

Descriptors: *Water Resources Research Act, *Missouri, Karst, Evapotranspiration, Flow, Legislation, Trace elements, Vibrations, Ecology, Chemistry, Groundwater, Roughness, Irrigation efficiency, Mine wastes, Sewage lagoons, Sediment transport, Water districts, Mine drainage, Soil permeability.
Identifiers: *Annual reports.

LIBRARY U. OF I. URBANA - CHAMPAIGN

Contains progress reports on 16 water resources research projects and planned studies on 12 new investigations. Included are studies of effects of ultrasonic vibrations on aerated biological systems; chemistry of water and improved chemical methods for trace amounts of ions in water; alternatives for water resources regulations, methods for measuring stream flow, ecology in waste assimilation by streams; trace element studies in the Missouri River; stream pollution in the 'Lead Belt', environmental factors in multi-purpose reservoirs; water penetration and storage in selected areas; analysis of public water supply districts; transport of sediment; separation of suspended solids, and sorption of chlorinated hydrocarbons by clay minerals. Information is included on the training of students in water science. Reports are given on participation in short courses and conferences pertaining to water resources. Also listed are activities of the Water Resources Research Center in contributing to public and academic affairs and for the promotion of improved water conservation and management. (Author)
W69-00980

INVENTORY OF RESEARCH IN WATER POLLUTION AND RELATED FIELDS: COLUMBIA BASIN AND PACIFIC COAST STATES.
Federal Water Pollution Control Administration, Corvallis, Oreg.
Lyman J. Nielson.
Fed Water Pollut Contr Admin Rep, Nov 1966. 135 p. Pub Health Serv-FWPCA Project 1263.

Descriptors: *Pacific Coast Region, *Pacific Northwest U.S., Alaska, *Columbia River Basin, Water pollution, California, *Water pollution, Control, Research and development, Hawaii, Idaho, Montana, Washington, Oregon, Wyoming, Utah.
Identifiers: British Columbia, Canada.

This is the seventh inventory of water pollution research for the Columbia River Basin and Pacific Coast States. In addition to the abstract of each research project, this issue provides information relating to distribution of efforts in various areas of water pollution research. Each researcher submitting data for the inventory was asked to indicate the pertinent research area or areas of his project. The data submitted are given in three tables. Table I, Allocation of Financial Resources, provides information on the relative distribution of research funds. Table II is a summary of the source of research funds. Table III provides data on personnel resources. The research summaries are grouped alphabetically by states. Each project has been numbered for indexing. In the research index each project is listed under all pertinent areas. The listing of each research project contains the following basic information as submitted: (1) title of project, (2) name of institution doing research, (3) summary or abstract of project including objectives, (4) date project was started, (5) estimated duration of project, (6) name of principal investigator, (7) number and disciplines of personnel on project, (8) equipment used, and (9) pertinent publications.
W69-01125

FISCAL 1968 ANNUAL REPORT OF THE WATER RESOURCES CENTER,
Pennsylvania State Univ, University Park, Pa.
John C. Frey, and E. Bruce Jones.
Institute for Research on Land and Water Resources, Information Report No. 56, University Park, Pa., Aug. 1968. 178 p, 5 append.

Descriptors: Acid streams, Eutrophication, Water pollution, Waste water disposal, Carbonates, Hydrogeology, Watershed management, Water pollution sources, Phosphates, Escherichia coli, Sewage effluents, Aquatic microbiology, Demand, Supply, *Training, *Universities, Grants, *Education, Allotments, Pennsylvania.

Twenty OWRR projects have been conducted during the 1967-68 Fiscal Year at the Water Resources Center of the Institute for Research on Land and Water Resources. The research projects concerned the neutralization of acid streams, stream eutrophication, stream pollution, waste water renovation, carbonate hydrogeologic environments, watersheds, numerical simulation of groundwater flow systems, phosphate removal from water, simplification of integrated stormwater planning, significance of Escherichia coli serotypes in sewage effluent and water supplies, and water demand-supply analyses. A 'Training and Education' section includes the names, degrees, and departments of students who have assisted the principal investigators of OWRR projects during some phase of their research. A listing of the public activities of the directors of the Institute and the principal investigators of OWRR projects during Fiscal Year 1967-68 is also included. These activities are listed under 'Meetings and Seminars,' 'Committees and Special Appointments,' and 'Public Law' headings. (Sink-Pa State)
W69-01194

1968 ANNUAL REPORT - WRRI - UNC, 34 pp, July 1968,
North Carolina State Univ, Raleigh, N. C.
David H. Howells.
Water Resources Research Institute, Raleigh, N. C.

Descriptors: *Water Resources Research Act, Allotments, Grants, Training, Universities.
Identifiers: Flood routing, Currents (Water), Pesticide residues, Methodology, Model studies, Eutrophication, Economic impact, Planning, Environmental effects.

Principal thrust was to expand research program with major new commitments for FY 1969 by the Raleigh and Chapel Hill campuses. The FY 1968 annual allotment was supplemented by $20,000 in University funds and additional $38,000 in services and facilities. Projects scheduled for completion in FY 1968: Routing of Flow in Streams in N. C.; Diffusion and Dispersion in Porous Media; Movement of Water in N. C. Soils and Effect on Water Quality; Ecology, Present and Alternative Future Land Use Patterns in Dismal Swamp; Current Study of Neuse River and Estuary; Oxygenation of Iron (II) in Continuous Reactors; Lake-Oriented Residential Subdivisions; Simulation of Regional Economic Impacts of Water Resources Development; Pigment Indices of Environmental Oxygen Stress. Projects continuing: Inventory of Water Resources in N. C.; Design of Monitoring System for Pesticides; Computer Simulation of Aquifers. Matching Grant projects: Exchange of Phosphorus Species Between Living and Nonliving Systems; Changes During Eutrophication of an Estuary. A graduate minor in water resources was offered for the first time. Six seminars were presented. Institute faculty were active in public affairs relative to water resources planning and management. The Institute Newsletter continued as the primary means of communication with public. (Author)
W69-01195

KANSAS WATER RESOURCES RESEARCH INSTITUTE ANNUAL REPORT FOR FISCAL YEAR 1968,
Kansas State University, Manhattan, Kansas.
Hyde S. Jacobs.
Kansas Water Resources Research Institute.

Descriptors: Evapotranspiration, Microclimatology, Regimen, Pesticides, Animal wastes, Fertilizers, Aerobic treatment, Groundwater movement, Dispersion.

The report contains brief summaries on institute involvement in public affairs, region approaches to water resources research, institute involvement in academic affairs, significant technical accomplishments, expected results from incomplete projects, publications resulting from the institute's research and brief narrative reports on the ongoing research. Technical accomplishments on such research as: animal feedlot pollution, nitrate removal from potable water, activity patterns of fish exposed to toxic materials, step aeration waste treatment systems, water contamination by pesticides, nitrate accumulation in groundwater and numerical modeling of groundwater flow are discussed. A summary of expected results on inorganic material removal, weather modification, microclimatology, evapotranspiration reduction, moisture use by wheat, logitudinal dispersion in river basins, groundwater recharge, river course and regimen, nitrate accumulation in water, pesticide contamination of water, feedlot pollution and aeration waste treatment systems is also included. Budgets for all matching grant and allotment grant projects as well as an over all budget summary are given. (Powers-Kansas State)
W69-01196

FOURTH ANNUAL REPORT, UNIVERSITY OF IDAHO. WATER RESOURCES RESEARCH INSTITUTE,
Idaho Univ., Moscow.
C. C. Warnick.
Annual Report - Water Resources Research Institute - Idaho, Volume 4, 79 p.

Descriptors: Literature, Education, Research Act Allotments.
Identifiers: Reports, Annual.

A resume of activity on 10 Allotment type research projects and one Matching Grant project was summarized. Three projects were completed including a study on movement of water from canals to the groundwater reservoir, a microclimate study of a transection across a river valley, and a study of indices for classifying chemicals which affect water quality for aquatic life. The Institute also assisted in initiating four separate water related studies in the University with the Idaho Water Resource Board. On one of these the Institute completed a two volume Water Inventory for Idaho. Ten graduate students were actively engaged in research projects supported by Office of Water Resources Research funding. (Author)
W69-01197

ANNUAL REPORT FOR FISCAL YEAR 1968,
South Dakota State Univ., Brookings, South Dakota. Water Resources Institute.
John L. Wiersma.
South Dakota Water Resources Institute, No. 3 Aug 1968. 121 p.

Descriptors: *Training, *Program, Agriculture Animal wastes, *South Dakota, Computer models Construction, Conservation, *Energy budget Evapotranspiration, Microclimatology, Sprinkle irrigation, *Water quality, Irrigation, Hydrographs Sinks, Synthesis, Spring, Salinity, Groundwate movement, Waste disposal, Permeability, Oxida tion lagoons.
Identifiers: *Report, *Public affairs, Biocides Economic potential, Information retrieva Resources inventory, Primary production.

The Water Resources Institute supported fourtee active research projects with emphasis placed o water supply augmentation and conservation i agriculture. The developing irrigated agriculture a well as the predominate dryland agricultur received attention. Water resources plannin received special attention including an evaluatio of the potential contribution of water resourc development in light of the Missouri River Basi development. Irrigation, as well as effect of larg water impoundments have received attention. predictive model is being tested. Water quali management and protection was studied in the lig of potential groundwater contamination fro urban refuse disposal as well as agricultural poll tion to surface waters including the determinatio of the levels of chemical biocides in the ecosyste of a prairie lake. The water retention chara teristics of waste water stabilization ponds was st died with results dictating revised design standard The program involved 230 students of which 1 graduated with 33 being employed by the Institut

9 disciplines with 6 new courses and 8 new staff members were represented. The Institute is becoming involved in public affairs through conferences and committees. (Author)
W69-01198

ANNUAL REPORT OF THE ARKANSAS WATER RESOURCES RESEARCH CENTER FOR FY68,
Arkansas Univ., Fayeteville. Arkansas Water Resources Research Center.
Aubrey E. Harvey.
Ark WRRC Annual Reports, 4th, Sept 1968, 241 p, 26 fig, 14 tab, 107 ref, 2 append.

Descriptors: *Subsurface irrigation, Automation, Thermal pollution, *On-site data collections, *Trace elements, Impoundments, Fertilizers, Pesticide residues, Interstate commissions, Viruses, Sedimentation, Groundwater, *Parasitism, *Water allocation (Policy), *Aquatic productivity, Eutrophication, Telemetry, Planning, Filtration.

10 project reports; FCST category IIK trace elements in impoundments 34 pp 7 fig 3 tab; IIIF automated subirrigation 8 pp 1 tab; IVB sedimentation and filtration in groundwater treatment 6 pp 2 fig; VB fertilizer-pesticide reaction in re soil water quality 4 pp, virus movement in groundwater 2 pp; VID water resources planning studies for Ark-Okla compact 5 pp; VIIG environmental changes in coldwater outlets from reservoirs 4 pp, water diversion effect on biota and water quality 56 pp 10 fig 4 tab; impoundment effect on water quality as reflected in bass parasitism 24 pp 4 fig 1 tab; VIIB telemetry for digital on-site water data collection 50 pp 3 fig. Center report contains information water related education and training at Univ of Ark and Ouachita Baptist Univ. Involvement in public affairs: representation on Governor's Coordinating Committee on Water Resources and State Committee on Stream Preservation, consulting on problems of thermal pollution in nuclear power generation, addresses to civic clubs and wildlife groups. Lists 3 publications and 5 theses resulting from projects.
W69-01199

ANNUAL REPORT - NEW JERSEY WATER RESOURCES RESEARCH INSTITUTE - 1967-1968,
Rutgers - the State University, New Brunswick.
William Whipple, Jr.
New Jersey Water Resources Research Institute 74 p, 6 illus, 2 tab.

Descriptors: Research grants, Research facilities, Water resources development, Economics, Urbanization, Biochemical oxygen demand, Dissolved oxygen.
Identifiers: Water resources research administration, Oxygen dynamics of streams, Metropolitan area water resources, Artificial river aeration.

A report on research and training activities of the New Jersey Water Resources Research Institute during fiscal year 1967-68 under provisions of P.L. 88-379. Includes mainly activities at Rutgers - the State University of New Jersey, with participation in specific projects by Princeton University and Stevens Institute. Research involved was funded mainly by the Office of Water Resources Research, but also by the Federal Water Pollution Control Administration, New Jersey State Department of Conservation and Economic Development, New Jersey State Department of Public Health, and the Delaware River Basin Commission. The program emphasizes three main fields of activity: (1) Oxygen dynamics and biochemical oxygen demand of streams, (2) metropolitan area water problems, and (3) economics of water resources. (Author)
W69-01200

FOURTH ANNUAL REPORT OF THE ARIZONA WATER RESOURCES RESEARCH CENTER,
Arizona Univ, Tucson.

Water Resources Research Center, The University of Arizona, Tucson, Arizona 85720. 57 p, August, 1968.

Descriptors: *Annual Report, Research, Education, Training, OWRR Programs.
Identifiers: *Arizona, *Water Resources Research Center, Annual Report FY '68.

The publication contains a brief summary of the research projects conducted in Arizona through the Water Resource Research Center. A financial summary of each project is included. New personnel and new courses of the Hydrology and Water Resources Program at The University of Arizona are listed. Research Projects summarized include studies of Gravity and Magnetic Surveys for Water Explorations, Soil-Water-Plant System Analysis, Salinity Effects on Plants, Social and Economic Studies of Water Use, Operations Research Methods Applied to Water Management, Soil Treatments to Increase Runoff, and a study of Trace and Tracer Elements in Ground Water.
W69-01201

ANNUAL REPORT, WATER RESOURCES RESEARCH ACTIVITIES UNDER PUBLIC LAW 88-379, FISCAL YEAR 1968, GEORGIA INSTITUTE OF TECHNOLOGY.
Georgia Institute of Technology, Atlanta, Georgia.

Water Resources Center, Georgia Institute of Technology, WRC-0368, August 1968. 108 p, 4 photos, 6 tab.

Descriptors: Ion exchange, Oxygen (Balance), Impoundment limnology, Piezometric surfaces, Cation adsorption, Phosphorous, Polarographic analysis, Hydrologic budget, Heavy metals, Aquatic ecosystems, Georgia water law, Ground water movement, Textiles, Stratified flow, Radioactive wastes, Manganese, Attitudes, Metropolitan planning, Water users.
Identifiers: Georgia, University of Georgia, Georgia Institute of Technology, Water resources research activities.

Progress on 24 projects in the research program active during FY 1968 and activity expected on 10 projects to be initiated in FY 1969 is outlined. Significant accomplishments to date and accomplishments anticipated for these projects are discussed. Three of the projects in the program deal with the nature of water; 8 of the projects are concerned with the water cycle, covering the hydrologic cycle, including water and plants, erosion and sedimentation, chemical processes, and estuarine problems; 2 are in the field of water quantity management and control; 8 deal with water quality management and protection; 10 are concerned with water resources planning, a good example of which is 'Interrelations between River Basin Developments and Development of Metropolitan Areas'; 1 involves the development of a method of determining and mapping the hydrologic response of ungaged watersheds in the Southeast; and 2 are in the field of engineering works. Information on student involvement and the training and educational aspects of the research program at both Georgia Tech and the University of Georgia is included. Involvement in professional, public service, and academic activities of personnel at Georgia Tech and the University of Georgia who are associated with the PL 88-379 research program is discussed.
W69-01202

ANNUAL REPORT 1967-1968.
Hawaii Univ, Honolulu.

Ann Rpt 67-68, Sept 1968. 126 p, 24 fig.

Descriptors: Hawaii, Floods, Hydrogeology, Aquifer characteristics, Geophysical exploration, Well logging, Ground-water tides, Ground-water recharge, Ground-water pollution, Water color, Tracers, Estuarine pollution, Hydrologic data, Irrigation, Evapotranspiration, Water values.

Annual progress report on the research program of the University of Hawaii Water Resources Research Center: the work reported includes studies of floods in small watersheds, aspects of the geohydrology of certain areas on Oahu, Maui, and Hawaii, surface geophysical exploration for ground water and geophysical well logging, tidal oscillations in ground water, identification of groundwater pollution effects, the pollution of certain estuaries, the removal of color from surface water, water tracing and dating, the design of hydrologic data network, the water use of sugar cane, and the value of water for irrigating sugar cane. (D. C. Cox-Hawaii).
W69-01203

FOURTH ANNUAL REPORT. PURDUE UNIVERSITY WATER RESOURCES RESEARCH CENTER. F.Y. 1968.
Purdue Univ, Lafayette, Indiana.
Dan Wiersma.
Report issued from Center Sept. 1, 1968. 93 p, 9 fig.

Descriptors: *Indiana, *Water Resources Research Act, *Training, Manpower, Allotments, Universities.

Purdue University Water Resources Research Center is supporting projects in watershed hydrology, geomorphology of stream beds and flood plains, classification of streams, statistical analysis of ground-water regimes, infiltration predictions, pesticide persistance in watersheds, urban hydrology, and water resources manpower needs. Some of the results reported included the development of a procedure whereby the runoff from small Indiana watersheds are predicted for any given storm; a statistical analyses of the ground water level regimes in Bartholomew County, Indiana delineating on the map areas of ground water surplus and deficiencies, and that the organophosphate and carbamate pesticide used on the Southern Indiana watersheds did not persist in the pond reservoirs nor in the soil of the watershed. In the latter results there were no effects on those terrestrial and aquatic organisms inventoried both before and after application of the pesticide. The report also contains a summary of the training activities in relation to water resources at the University. It also relates the water Resources Center's involvement in such activities as the State Water Plan, Legislative Advisory Committees, and Interstate Commissions. (Author)
W69-01204

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Kentucky Univ., Lexington, Kentucky.
Robert A. Lauderdale.
Report for FY 1968, Kentucky Water Resrcs Inst, Lexington, 1968, 141 p.

Descriptors: Recreation demand, Flood control, Pesticides, Strip mines, Non-structural alternatives, Water law, Chemical oxidation, Geochemistry, Water chemistry, Aesthetics, Soil water, Capillary water, Acid bacteria, Soil water movement.

During FY 1968 the University of Kentucky Water Resources Institute supported fourteen new or continuing projects under section 100 of P.L. 88-379. The subjects covered include (1) the economic analysis of alternative flood control measures, (2) persistence of pesticides in impounded waters, (3) the economic impact of flood control reservoirs, (4) ecological study of the effects of strip mining on the microbiology of streams, (5) chemistry of the oxidant ferrate, its interaction with specific organics found in waste water, (6) solution

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geochemistry of the water of limestone terrains, (7) aesthetic and recreational potential of small naturalistic streams near urban areas, (8) capillary-diffusion and self-diffusion of liquid water in unsaturated soil, (9) evaluation of the legal institutions of diversion, transfer, storage, and distribution of water in Kentucky, (10) a preliminary reconnaissance of areas to be impounded in the Salt River Basin of Kentucky, (indicates completion report available). The annual report includes statistical data on the training and other activities of the Institute during FY 1968. (Author)
W69-01205

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Thomas P. Schlunz, Robert M. Sutton, and George W. White.
Final Rep, Water Resour Center, Aug 1967. 77 p, 85 ref. OWRR Project A-017-Ill.

Descriptors: *Bibliographies, History, *Water resources, Natural resources, Evaluation, *Illinois.

This bibliography consists of travel narratives and descriptive accounts of Illinois written by observers who were in the state or who wrote of the state between the years 1673 and 1850. These limits were chosen because the first recorded European set foot on Illinois soil in 1673, and after the middle of the nineteenth century the official state and federal geological reports can be relied upon. The works included in this list were chosen because the authors of them recorded observations bearing on the state of the water resources in Illinois at the time of their visits or publication. The entries in the bibliography consist of the titles, an introductory and summary paragraph, and the pertinent selections from the works. The two criteria in assembling this bibliography were that the work contain matter relating to the water resources of Illinois, and that the work was published and therefore received wide circulation. The bibliography is arranged alphabetically. A chronological list of the works, in the order of the years of observation, when known, or by order of publication, follows the bibliography.
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 2, NUMBER 4
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NEW SERIES

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is $22.00 (domestic), $27.50 (foreign); single copy price is $3.00.

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WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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VOLUME 2, NUMBER 4
FEBRUARY 15, 1969

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States--now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

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To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
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SELECTED WATER RESOURCES ABSTRACTS

02. WATER CYCLE

2A. General

AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN METEOROLOGICAL VARIABLES AND STREAMFLOW.
Rutgers University, New Brunswick, N. J. College of Agriculture and Environmental Science.
Joseph L. Horowitz, and Mark D. Shulman.
Water Resour Bull, AWRA, Vol 3, No 3, pp 21-31, Sept 1967. 11 p, 6 fig, 3 tab, 4 ref. OWRR Project A-002-NJ.

Descriptors: *Synthetic hydrology, Streamflow, Runoff, New Jersey, Statistical models, Low flow, Base flow, Drought.
Identifiers: *Thornthwaite method.

Analyses are presented relating streamflow and meteorological variables. In one approach a physical model was developed and yielded a correlation coefficient of .857 between streamflow and Thornthwaite runoff. The resulting linear regression equation had a standard error of 37.10 cfs and could be used to develop a synthetic streamflow sequence with best results during low flow situations. A second approach used a linear stepwise multiple regression analysis to relate streamflow and monthly values of antecedent precipitation and Palmer runoff. This model yielded an equation with six predictors and a multiple correlation coefficient of .877 and a standard error of 35.21 cfs. The first approach is preferred in that the comparative loss in the reduction of variance is outweighed by the simplicity of the method. (Shulman-Rutgers)
W69-01249

ANALYSIS OF OVERLAND FLOW ON SHORT EROSION PLOTS,
Purdue Univ, Lafayette, Indiana.
George R. Foster.
Part of OWRR Project B-003-IND: 'Mathematical Simulation of Hydrologic Events on ungaged Watersheds', 1968. Master of Science Thesis, Department of Agricultural Engineering, Purdue University, 1968. 138 p, 43 fig, 5 tab, 4 append.

Descriptors: *Erosion, *Sedimentation, *Overland flow, Runoff, Reynolds number, Chezy equation, Retention storage, Infiltration, Manning's equation, Roughness, Surface profiles, *Agricultural watersheds, Runoff coefficient, Hydrograph analysis.
Identifiers: Coefficient of friction.

An analytical overland flow model of a watershed runoff hydrograph is proposed that satisfactorily predicts runoff for short agricultural slopes. The developed model is a kinematic model that mathematically is the combination of the continuity equation and the Chezy uniform flow relationship. The model includes retention storage, provisions for a variable point infiltration rate and a variable coefficient of friction, the 'drying up' of the upstream end of the slope during recession and a variable area infiltration rate that is a function of the water surface area during recession. An implicit finite difference scheme is used to evaluate the continuity equation, and the model is programmed in FORTRAN IV for numerical evaluation on a digital computer. Field hydrographs from fallow erosion study plots were analyzed for retention storage and predicted coefficients of friction. These results were used in the model to simulate hydrographs which were compared with field hydrographs to test concepts used in the model. The model with a constant coefficient of friction or Manning's 'n' adequately describe overland flow on short agricultural slopes. (Author)
W69-01408

AQUIFER AND MODELS,
U. S. Geological Survey, Albuquerque, N. Mex.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-01443

AN EVALUATION OF THE INFLOW-RUNOFF RELATIONSHIPS IN HYDROLOGIC STUDIES,
J. Amorocho, and G. T. Orlob.
Univ. Calif, Wat Resour Center Contrib No 41, 1961. 70 pp.

Descriptors: *Rainfall-runoff relationships, *Model studies.

Studies have been carried out by the University of California to establish some of the criteria required for the interpretation of statistical analyses of the relation between rainfall and run-off. For this purpose, a model of an hydrological unit was developed, based on a qualitative analysis of its fundamental functional elements, and its structure was compared with that of a typical regression equation. The conditions for minimum error in the estimates of flow from catchments were examined and various watersheds in different parts of the world were investigated to test the applicability of the equations of state developed. The advantages of using an equation of state for hydrologic studies in preference to wholly empirical relations derived from more or less arbitrary multiple correlation analyses are indicated.
W69-01555

STEPS TOWARD A BETTER UNDERSTANDING OF URBAN RUNOFF PROCESSES,
E. F. Brater.
Water Resources Res, Vol 4, No 2, p 335, April 1968.

Descriptors: *Rainfall-runoff relationships, Drainage systems, Surface runoff, *Storm runoff, Groundwater.

Rainfall and runoff from drainage basins in various stages of urbanization were analyzed to determine the initial retention, the hydrologically significant impermeable area, and the infiltration capacities of the permeable portions of the basins. The drainage basins, varying in size from 9.5 to 185 square miles, are located in the Detroit metropolitan area. Techniques were developed that largely eliminated personal judgment in separating surface runoff from ground water discharge. Infiltration capacities in this region are from 3 to 5 times higher in late summer than in early spring. The average initial retention for the basins studied is approximately 0.2 inch. The hydrologically significant impermeable area appears to be closely related to the population density, but the effect of other factors is being studied. An investigation of the cause of seasonal and short period variations of infiltration capacity may provide a better understanding of the infiltration process.
W69-01563

COMPUTATION OF OPTIMUM REALIZABLE UNIT HYDROGRAPHS,
Peter S. Eagleson, Ricardo Mejia-R, and Frederic March.
Water Resources Res, Vol 2, No 4, pp 755-764, 1966. 6 fig, 22 ref.

Descriptors: *Rainfall-runoff relationships, *Computer programs.
Identifiers: Calculations, *Urban hydrology.

The Wiener-Hopf theory of optimum linear systems is applied to the determination of the stable pulse response of a monotone hydrologic system from coincident records of input and output in the form of discrete time series. In application to the rainfall-runoff system, linear programming methods are used in the solution of the Wiener-Hopf equations to obtain physically realizable unit hydrographs. An actual urban rainfall-runoff event is graphed and used for illustration in developing the equation.
W69-01567

SCALE MODEL OF URBAN RUNOFF FROM STORM RAINFALL,
R. A. Grace, and P. S. Eagleson.
ASCE Proc, J Hydraulics Div, Vol 93, No HY3, pp 161-176, May 1967.

Descriptors: Storms, *Model studies, Storm runoff.
Identifiers: *Urban drainage.

The response of a small urban watershed to four storms is generated in the laboratory by a scale model consisting of a programmed rainfall generator, vertically-distorted scaled topography, and a weighing device for recording the cumulative runoff. Comparison of these results with prototype measurements through use of derived scaling laws shows reasonable agreement.
W69-01570

ON STRUCTURE OF COAXIAL GRAPHICAL RAINFALL-RUNOFF RELATIONS,
A. Becker.
Int. Assn Sci Hydrology-Bul, Vol 11, No 2, pp 121-30, June 1966.

Descriptors: *Rainfall-runoff relationships, *Rainfall intensity.

This paper, supported by investigations into extreme conditions and events--i.e., moisture-oversaturated river basin, threshold concept, instantaneous rainfall and rainfall of extreme amount--supplies general information on structure of coaxial graphical rainfall-runoff relations and on physical laws primarily controlling shape of curves in individual quadrants of coaxial relations.
W69-01575

CONCEPTION OF A MODEL FOR DETERMINING THE LAWS OF RAIN DISCHARGE RELATIONS ,
A. Becker.
Wasserwirtsch-Wassertech, Vol 18, No 1, pp 16-21, Jan 1968.

Descriptors: *Model studies, *Rainfall-runoff relationships, Flow measurement, *Surface runoff, Runoff forecasting.

Rain discharge relations, especially on the surface of rivers, play a significant role in the forecasting of floods, because they make it possible to achieve a maximum time advance in making the forecasts. A model is developed (based on unit territorial and rain relations) to deduce the rain discharge relationships from threshold values and other simple quantities. An example is given for which - on the basis of favorable conditions - an approximate determination of the surface water retention was possible by considering the surface water states at two representative measuring stations.
W69-01576

SURVEY OF RECENT DEVELOPMENTS IN RAINFALL-RUNOFF ESTIMATION,
F. C. Bell.
Instn Engrs, Australia-J, Vol 38, No 3, pp 37-47, March 1966.

Descriptors: Rainfall intensity, *Computer programs, *Rainfall-runoff relationships, *Model studies.

Advances in estimating streamflow from given quantities of rainfall that were made by simulating hydrological phenomena with high-speed computers are surveyed; it is shown that some of these techniques are based on rather artificial models of physical processes and could give poor predictions for extreme or uncommon conditions; individual processes are studied and it is suggested that most models could be improved.
W69-01577

A MATHEMATICAL MODEL FOR RELATING RUN-OFF TO RAINFALL WITH DAILY DATA,
W. C. Boughton.
Civ Eng Trans, Inst Engrs Australia, Vol CE8, No 1, pp 83-97, 1966.

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Descriptors: *Model studies, *Rainfall-runoff relationships, Rain gages.

The author describes the development and use of a mathematical model to simulate the changes of moisture in a catchment using daily rainfalls and evaporation records as data; the principal physical processes reproduced in the model, namely, evapotranspiration losses, soil moisture storage, and infiltration losses, are discussed. The model has been used with records from 6 gauged catchments in New South Wales, and showed reasonable correlation between recorded and estimated run-offs; the results also suggested a possible explanation of the difference in infiltration rates between plot experiments and natural catchments.
W69-01579

RAINFALL-RUN-OFF RELATIONS IN THE UPPER GOULBURN RIVER CATCHMENT, N.S.W.,
T. G. Chapman.
Civ Eng Trans, Inst Engrs, Vol CE5, pp 25-35, Aug 1963.

Descriptors: *Rainfall-runoff relationships, *Rain gages, *Storm runoff, *Groundwater recharge, *Rainfall intensity.
Identifiers: *Calculations.

The author describes the methods developed to determine the relation between rainfall and run-off in the Upper Goulburn river catchment in New South Wales, a large catchment for which records of stream flow and daily rainfall were available but there were no data on rainfall intensity. The network of official rain gauges was supplemented by records from privately-operated instruments; these had a slightly lower standard of consistency but were of adequate quality for use in the analysis. Linear regression techniques were used to estimate mean winter and summer rainfalls for each station for a common 50-year period; isohyetal maps for mean seasonal rainfalls were then developed by correlating the estimated rainfall for each station with its altitude and a third variable dependent on topography or location. About 75 per cent of the variation in rainfall was accounted for in this way, compared with 37 per cent when altitude was the only variable. The stream-flow record was used to estimate, within wide limits, the mean annual recharge to ground water and to calculate the direct run-off from 242 storms in 47 years. The relation between rainfall and run-off was developed by multiple regression analysis, which was first used to compare the efficiency of different predictors of rainfall intensity and catchment dryness.
W69-01583

LABORATORY STUDY OF WATERSHED HYDROLOGY,
V. T. Chow.
Paper, Int Hydrol Symp, Fort Collins, Colo, Sept 1967, U of Illinois, Urbana. 14 p, 3 fig, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Watersheds, *Storm runoff, *Model studies, *Computer programs, *Roughness (Hydraulic), Discharge (Water).

A conventional approach to study the rainfall-runoff relationship of a watershed uses historical hydrologic data to fit a black-box model for simulation of watershed hydrologic behavior. Although many measurements of rainfall input and runoff output from watersheds are available, no general theory explaining the course of flow mechanics from input to output exists. The proposed laboratory approach investigates basic laws and principles controlling mechanics of runoff from a watershed. It employs a watershed experimentation system (WES) as a tool for the research. The WES is an instrumentation system of integrated hydraulic, electronic, and structural design that can produce an artificial rainfall of variable time and space distribution to move over a laboratory area of 40 by 40 ft or less; thus, it is capable of simulating a storm moving in any direction over a testing drainage basin constructed within the area. The experiment is controlled electronically by a digital computer, and output runoff is measured by sonar detectors which transmit information to the computer for immediate recording and analysis. Various problems being studied include the time factor in runoff process, conceptual watershed roughness, and effect of storm movement on peak discharges. The WES also may be used to study subsurface runoff by employing testing basins made of porous materials.
W69-01584

SEQUENTIAL GENERATION OF RAINFALL AND RUNOFF DATA,
V. T. Chow, and S. Ramaseshan.
ASCE Proc, J Hydr Div, Vol 91, No HY 4, Pt 1, paper 4416, pp 205-23, July 1965.

Descriptors: *Storm runoff, *Drainage systems, *Rainfall-runoff relationships.
Identifiers: *Calculations.

Practical procedure is demonstrated by applying sequential generation techniques to rainfall and runoff data for stochastic, hydrological analysis of drainage basin systems; in this method, stochastic process is formulated by several major components including hourly annual storm rainfalls, abstractions, routing model, baseflow, direct runoff, and total runoff: 1000 annual storms are generated sequentially by Monte Carlo methods and then routed through simulated basin system to produce 1000 generated floods which are represented by stochastic flow-duration curves for use in water resources planning and design.
W69-01585

CONCEPTUAL MODEL OF HYDROLOGIC CYCLE,
N. H. Crawford, and R. K. Linsley.
Int Geodetic and Geophysical Union-Soc for Sci Hydrology Pub, No 63, pp 573-87, 1964.

Descriptors: *Model studies, *Watersheds, *Hydrographs, Groundwater, *Storm runoff, Rainfall-runoff relationships, *Computer programs.

Model called Stanford Watershed Model (Mark II) utilizes hourly ordinates of hydrograph during and immediately after rain and mean daily ordinates for interim periods; print-out includes monthly and annual flow, monthly groundwater runoff, end of month soil moisture, and flow duration curve of daily runoff; model includes among its components surface, interflow, and groundwater runoff; model has been tested on basins embracing variety of climate, hydrologic, and geologic conditions.
W69-01586

LIMITING FACTORS IN RAINFALL RUN-OFF,
L. B. Escritt.
Engr, London, Vol 213, 1962.

Descriptors: *Rainfall-runoff relationships, *Storm runoff, Storms, *Rainfall intensity, Design, Sewage treatment, *Runoff forecasting.
Identifiers: *Surface permeability.

When sewerage systems are being designed, the volume of storm water is often over-estimated because no allowance is made for change of impermeability during rainfall. In addition, in large catchment areas, heavy storms frequently cover only part of the total catchment, and when run-off is calculated by relating statistics of frequency, intensity and duration of rainfall to impermeable area by a time-of-concentration method, the flow may be considerably over-estimated. The author suggests methods for allowing for the change of impermeability during rainfall and for assessing the maximum areas likely to be covered by storms.
W69-01589

RAINFALLS OF SHORT DURATION AND HIGH INTENSITY: AN ALTERNATIVE TO BILHAM'S FORMULA,
L. B. Escritt.
Water Waste Treatment J, Vol 7, 1960.

Descriptors: *Rainfall intensity, Design, *Surface runoff, *Sewers.
Identifiers: *Storm sewers.

In connection with the design of surface water sewers, the author discusses the use of Bilham's formula for rainfalls of short duration and high intensity, and presents a modified general intensity formula derived from logarithmic plotting based on Bilham's formula.
W69-01590

COMPUTING RUNOFF FROM SMALL WATERSHEDS,
C. L. Hamilton.
Pub Works, Vol 96, No 8, pp 106-8, Aug 1965.

Descriptors: *Storm runoff, *Rainfall intensity, Watersheds.
Identifiers: *Calculations.

Use of summation 'W' method for estimating runoff from small watersheds, with 'W' standing for relative valves of certain physical watershed characteristics that are summed up to obtain preliminary estimate of peak discharge; rainfall factor was developed to make adjustment in rainfall intensity as it varies throughout United States in reference to intensity chosen as standard; sample computation is presented to illustrate application of method; data on runoff-producing characteristics of watershed with corresponding weights.
W69-01593

2B. Precipitation

CALIFORNIA HIGH WATER, 1965-1966.

California, Dept Water Resources-Bul 66-69, Aug 1967. 61 p.

Descriptors: Rainfall-runoff relationships, Precipitation intensity, *Storm runoff, Storms.
Identifiers: California.

This report provides information on meteorology, rainfall-runoff, and damages resulting from major storms of 1965-66 water year; it describes general weather patterns preceding and during storm periods, including precipitation characteristics and discusses resulting runoff in seven hydrograph areas of state; it presents information on flooded areas and damages; two storms during Nov 1965 recorded total of 30 in. of precipitation and one day maximum of 12.4 in. at station in Santa Ana River Basin.
W69-01498

TIME ANALYSIS OF RAINFALL ON URBAN CATCHMENT,
V. J. Bidwell.
J Hydrology, New Zealand, Vol 6, No 2, pp 74-9 1967.

Descriptors: *Rainfall intensity, *Computer programs, Rain gages.
Identifiers: *Urban drainage, *New Zealand.

Analysis of short-time-increment rainfall at University of Auckland in New Zealand; autocorrelation techniques proposed by R. A. Grace and P. S. Eagleson were used; practical methods of data recording and processing, suitable for digital computer analysis, are outlined; autocorrelation results are given for 1 yr of 10-min rainfall values for Albert Park gage at Auckland.
W69-01561

RELATION OF ANNUAL RUNOFF TO METEOROLOGICAL FACTORS,
M. W. Busby.
U S Geol Survey-Prof Paper 501-C, p C188-9, 1964.

Descriptors: Runoff, *Runoff forecasting, Rainfall-runoff relationships.

Average annual runoff at 62 selected stations throughout conterminous United States was related to nine meteorological factors as recorded at U S Weather Bureau first-order weather station near each point of runoff study; seven of these factors were significant at 80% level or higher; on basis of these seven factors, standard error of estimate of average annual runoff is about 30%.
W69-01582

2C. Snow, Ice, AND Frost

EFFECT OF SNOW COMPACTION ON RUNOFF FROM RAIN OR SNOW,
F. A. Bertle.
U S Bur Reclamation-Eng Monographs, No 35, June 1966. 45 p.

Descriptors: *Runoff, *Snowmelt, Design storm, *Rain.

Computational procedure for determining water available for runoff and its time of occurrence resulting from rain-on-fresh-snow condition; procedure includes estimate of shrinkage of snow pack caused by metamorphosis of crystalline structure with addition of rainfall; examples are given showing use of procedure with assumed design storm conditions; procedure is used to reproduce observed flood which verifies accuracy of method and assumptions and is intended for use in inflow design flood study in which design rain occurs on fresh snowpack.
W69-01578

DETERMINATION OF THE MELT-WATER FLOW FROM THE WATER RESOURCES OF THE SNOW COVER,
H. J. Grasnick.
Wasserwirtsch-Wassertech, Vol 17, No 9, pp 302-306, Sept 1967.

Descriptors: *Snowmelt, *Runoff.
Identifiers: *Calculations.

With the aid of several statistical methods, an attempt was made to work out a prognosis for the melt-water run-off (as well as the total run-off at peak values) in some river areas of the German Democratic Republic showing various physical and geographical conditions. The investigation made use only of observation data published in the meteorological and hydrological annuals. Although this material, especially that about the snow cover, did not permit the desired fully complex statistical evaluation, nevertheless, it was possible to find certain regularities in the relationship between the water resource and run-off. The report contains results of a differential analysis of special snow investigations carried out in Spring 1965 and the author's suggestions on how to improve observation of the snow cover.
W69-01592

2D. Evaporation and Transpiration

WATER REQUIREMENTS FOR INCREASED ARID LAND PRODUCTIVITY,
George H. Hargreaves.
Agency for International Development; Centro Interamericano de Desarrollo Integral de Aguas y Tierras, Project 213, Bogota, Colombia.

Descriptors: *Water requirements, *Arid lands, *Precipitation (Atmospheric), Evaporation, *Evapotranspiration, Moisture availability, Meteorological data, Consumptive use, Productivity, Evaporation pans, Equations, Rainfall disposition, *Climatic data.
Identifiers: Formulas, Moisture index.

Measured or computed evaporation and potential evapotranspiration, when combined with rainfall and effective precipitation, provided a valuable and useful index of moisture needs or deficiencies for forage or crop production in arid climates. Formulas were presented for computing evaporation from climatic data. Evaporation can be calculated from temperature data alone. Production was probably directly related to the degree to which the potential evapotranspiration or consumptive use requirements were supplied by available moisture. Methods for improving moisture availability were listed and described. The ratio of effective precipitation to potential evapotranspiration Pe/Etp was proposed as a useful and valid index for the classification of climate. (Blecker-Ariz)
W69-01470

2E. Streamflow and Runoff

UNSTABLE MISCIBLE FLOW IN HETEROGENEOUS SYSTEMS,
California University, Los Angeles.
R. L. Perrine, and G. M. Gay.
2d Preprint, Symp, 58th Nat Meeting, Amer Inst Chem Eng, New York, NY, Feb 1966. 35 p, 8 fig, 2 tab, 6 ref, append.

Descriptors: Numerical analysis, Flow, *Heterogeneity, Porous media, Mathematical models, *Computer models, Analytical techniques, Oil reservoirs, Dispersion, Approximation method, Flow characteristics, Three-dimensional.
Identifiers: *Flow instability, Miscible displacement, Linearized, Perturbation method.

Amethod is described of numerical computation for three-dimensional unstable miscible displacement behavior useful for heterogeneous systems, as well as under more ideal conditions. Flow equations are first linearized by a perturbation approach. The basic flow is separated and a solution for its behavior readily obtained. The remaining problem of deviations from the basic flow caused by nonideal conditions is subjected to numerical analysis. Results obtained from the method are presented. The following conclusions have been drawn: although the conditions assumed in test calculations have been severe, results obtained show the dispersing flow expected, and appear satisfactory. The method eliminated or reduced in importance problems of oscillating values near steep fronts and excessive computer smoothing. An unique advantage of the method is that one can see the source of variations from ideal behavior. One serious drawback results from the algebraic complexity of the perturbation approach, and the need for second order terms to be retained in calculations of interest. Fewer array points are available and more computer time is required than would be desired. These difficulties also are experienced with other approaches to the solution of three-dimensional displacement problems.
W69-01247

HYDRAULIC MODEL OF RUNOFF FROM DEPRESSIONAL AREAS,
Kentucky Univ., Lexington; Iowa State Univ., Ames.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01436

A DYNAMIC SIMULATION OF THE LOWER KANSAS RIVER DRAINAGE SYSTEM,
Federal Water Pollution Control Administration, Atlanta, Ga; University of Kansas, Lawrence.
Albert R. LeFeuvre, and Ernest C. Pogge.
Amer Soc Civ Eng, Hydraul Div 16th Annu Spec Conf, Massachusetts Inst of Technol, Cambridge, Aug 1968. 41 p, 14 fig, 2 tab, 8 ref, disc, append.

Descriptors: *Drainage basins, *Watersheds, *Simulation, Hydrographs, Outflows, Hydrometeorological station, *Models, Discharges, Reservoirs, Rivers, Dynamics, Hydrology, Runoff, Streamflow, Streamflow forecasting, Computer programming.
Identifiers: *Hydrologic models, *Lower Kansas Riv Valy (Kans), *Kansas River Basin, *Model studies, *Mathematical models, Gaging stations.

A digital computer was used to simulate dynamic response of the Lower Kansas River Drainage System to unsteady hydrologic inputs. The model accounts for local inflow and upstream conditions. Boundary conditions for the model were the average daily flow hydrographs observed at 20 tributary stream gages. The hydrology of the river system was incorporated into a water quality model that simulated the distribution of conservative and nonconservative pollutants throughout the drainage system. Only the flow simulation is discussed. The model was verified by comparing machine-generated hydrographs for 5 mainstem stream gages with the corresponding observed hydrographs. Six time periods of approximately 40 days each are presented as verification of the model. (USBR)
W69-01468

HYDRAULICS RESEARCH 1963 AND 1964. THE REPORTS OF THE HYDRAULICS RESEARCH BOARD WITH THE REPORTS OF THE DIRECTOR OF HYDRAULICS RESEARCH.

Department of Sci and Ind Res and the Ministry of Tech, 1964 and 1965, 84 pp and 96 pp.

Descriptors: *Hydraulics, *Runoff, *Drainage, *Pipes, *Storm runoff, Estuaries, Model studies, Sewage effluents.
Identifiers: Surface permeability, *Combined sewers.

Hydrological studies reported include: the factors affecting run-off in a permeable (chalk) catchment area and stream flow in an impermeable catchment; the effect of afforestation on the water balance of a catchment area; and lysimeter experiments on factors affecting evapotranspiration and drainage. Studies have continued on the attenuation of flood waves in partly-filled pipes, including tests on the mixing of an incoming surge of relatively clean storm sewage with the grossly polluted sewage in a combined sewage system. Studies on estuaries and tidal flow, carried out both in models and in the field, have included the problems of silting, dispersal and recirculation of heated effluents discharged from power stations, and dispersal of sewage effluents from outfalls, including flume tests on dispersion in steady turbulent flow.
W69-01516

THE USE OF UNIT-SOURCE WATERSHED DATA FOR RUN-OFF PREDICTION,
C. R. Amerman.
Wat Resour Res, Vol 1, pp 499-507, 1965.

Descriptors: *Runoff forecasting, *Demonstration watersheds, Subsurface runoff, Storms.

Run-off from 10 units forming a 76-acre complex watershed and from 2 units forming a 7.4-acre complex watershed in the North Appalachian experimental watershed near Coshocton, Ohio, was measured during storms during 1956. The partial run-off values were used to calculate a theoretical value for the run-off from each complex watershed, which was compared with the observed run-off. For the 76-acre watershed, the observed run-off was very much larger than the estimated run-off for small storms, but the two values approached as the storm size increased; in the case of the 7.4-acre

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watershed the estimated value was very much larger than the observed run-off for small storms and almost equal to it for large storms. In order to produce a better model for this type of calculation it was concluded that the question of sub-surface run-off, partial area flow, and the influence of run-off from the upper slopes on that from lower areas, should be considered.
W69-01554

ASCE RESEARCH PROGRAM IN URBAN WATER RESOURCES.
Civ Eng, Vol 38, No 5, pp 70-71, May 1968.

Descriptors: Data collections, *Design, *Storm drainage, Instrumentation, *Rainfall-runoff relationships, *Water quality, Model studies, Drainage systems.
Identifiers: *Urban drainage, *Urban hydrology.

The ASCE Urban Hydrology Research Council has initiated a program to study and report on research and data needs for urban-water problems. The program currently consists of two major projects: Research and Analysis of National Basic Information Needs in Urban Hydrology and Systematic Study and Development of Long-Range Programs of Urban Water Resources Research. Under the first project an intensive study is being made of the types of data needed for improved design of storm-drainage facilities, including both quantity and quality of drainage-flow needs for data-collecting instrumentation; and for approval of types of networks necessary to collect adequate data. The ultimate objective is to facilitate transfer of data findings between metropolitan regions. The second project will attempt to provide guidelines for initiating and expanding a program of long-range studies on urban water problems. This includes: prefeasibility studies to determine the possible effectiveness, cost and time requirements for a comprehensive systems-engineering analysis of all aspects of urban water and for a general economic analysis of costs and pricing parameters of all aspects of urban water; a state-of-the-art study of mathematical models and related techniques for analyzing urban rainfall-runoff-quality processes; a study of requirements for the assessment of drainage damage and exploration of alternatives to direct storm-water runoff; and a study of political, economic, legal, and social problems related to urban water management.
W69-01557

SCALE MODEL OF URBAN RUNOFF FROM STORM RAINFALL,
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01570

SOLUTION TO SURFACE RUNOFF PROBLEM,
A. Y. Abdel-Razaq, W. Viessman, Jr., and J. W. Hernandez.
ASCE Proc, J Hydraulics Div, Vol 93, No HY6, Paper 5606, pp 335-52, Nov 1967.

Descriptors: *Hydrographs, Runoff, Surface runoff.

Surface runoff hydrographs are computed by relatively simple method consisting of reducing governing partial differential equations to ordinary differential equations at several nodal points along flow plane; these equations are then solved for time derivatives which are used in Taylor's series to approximate velocity and depth after increment in time; comparison with experimental data shows that runoff hydrographs were reproduced fairly accurately; numerical solution was shown to be stable and truncation errors negligible.
W69-01572

PROBLEMS OF HYDROLOGICAL FORECASTS.
Studii Hidrol, Inst Studii Cerc Hidroteh, Vol 13, 1965. 208 pp, 2 tab.

Descriptors: *Runoff forecasting, *Hydrographs, Discharge (Water).
Identifiers: Roumania.

This publication contains the full text of 5 papers on the prediction of run-off and stream flow with special reference to conditions in Roumania. Aspects considered include the short-range forecasting of run-off by the trend method; forecasting of hydrographs of floods caused by precipitation, using the isochrones method; forecasting of mean discharges in the Danube over periods of 10 and 5 years, based on the water resources in the drainage area; short-range forecasting of discharges in the rivers Somes, Mures, Jiu, Olt, and Siret, based on water resources in the drainage area; and short-range forecasting of freezing and the breaking-up of ice on Roumanian rivers.
W69-01573

RESEARCH REPORT OF THE CITY AND GUILDS COLLEGE, 1961-64.
Imperial College of Science and Technology, (University of London).

110p.

Descriptors: *Rainfall-runoff relationships, Computer programs, Model studies.
Identifiers: *Calculations.

This report includes sections on engineering hydrology (pp. 53-54) and public health engineering (p. 54). Studies on surface waters have included the flood response of a river to rainfall, propagation of a flood wave along a river, mechanism of run-off from an artificial catchment receiving 'rain' from a sprinkler, design of a network of hydrometric stations, and the use of modern techniques, including digital and analogue computers, to analyse hydrological data and investigate the relations between rainfall and run-off. A mathematical study was made of the flow of irrigation and rain water to horizontal tube drains, and the mathematics of diffusion were applied to the description of unsteady flow of ground water. Studies were also made on the relation between hydrology and water demand, particularly for irrigation, and on the management and planning of water resources, including the design and operation of storage reservoirs. In connexion with water and sewage treatment, model and prototype studies were made on the mixing characteristics of horizontal-flow sedimentation tanks, and work on mixed-bed filtration led to the development of an efficient graded filter with layers of polystyrene, anthracite, sand and garnet, the strata being graded so that they retain their relative positions during back-washing and so that the pore space decreases in the direction of flow, with consequent deeper penetration of removable material.
W69-01574

A TECHNIQUE FOR ANALYSIS OF RUN-OFF HYDROGRAPHS,
D. L. Brakensiek.
J Hydrol, Vol 5, pp 21-32, 1967.

Descriptors: *Hydrographs, *Runoff, *Computer programs.

A single function, based on a transformation of the Pearson type III equation, was used to fit simple hydrographs, provision being made for the independent evaluation of discharges for the rising and falling limbs. Fitting principles, including those for computer use, are discussed and detailed, and a Fortran II source programme written for an IBM 1620 computer is listed. Using an on-line plotter, calculated hydrograph points were compared visually with observed curves.
W69-01580

UNIT GRAPHS FOR NONUNIFORM RAINFALL DISTRIBUTION,
J. A. Buil.
ASCE-PROC, J Hydraulics Div, Vol 94, No HY1 paper 5762, pp 235-57, Jan 1968.

Descriptors: Drainage, *Runoff, *Hydrographs.

Correlation between Snyder's basin constants C and 640 Cp and basin physical characteristics o drainage area, total length, average slope length t center of area, and elongation is established usin synthetic data; actual data are used to compensat for discrepancies introduced through initial use o synthetic data; effects of nonuniform rainfall dis tribution on basin runoff hydrographs represented by unit graph, selected from thre computed for each basin; computation formula are presented to define each of three basin uni graphs; dimensionless unit graph is introduced fo more accurate definition of rising and falling link of each unit graph.
W69-01581

DISCHARGE FROM HEAVY RAINFALL,
E. E. Dawson.
Proc Inst Civ Engrs, Vol 25, pp 373-374, 1963.

Descriptors: *Discharge (Water), *Rainfall-runo relationships.

In connexion with previous work on discharge fro heavy rainfall, further studies have shown that n serious error was introduced by treating the flow uniform (whereas the flow on the ideal catchme would be non-uniform) provided that th catchment was not very small.
W69-01587

2F. Groundwater

STORAGE OF FRESH WATER IN UN DERGROUND RESERVOIRS CONTAININ SALINE WATER: PHASE I,
Kansas University, Lawrence.
Don W. Green, and Ronald L. Cox.
Kansas Water Resour Res Inst Rep, Kansas Sta Univ, Manhattan, Aug 1966. 96 p, 8 fig, 1 tab, chart, 28 ref, 4 append. OWRR Project B-003-Ka

Descriptors: Diffusivity, Groundwater recharg Recharge wells, Saline water intrusion, U derground storage, Dispersion, Gravity studie Computer models, Computer programs, Math matical models, Saline water-freshwater interface Groundwater movement.

A computer model has been developed for applic tion to salt water-fresh water displaceme processes in porous media. It is based on the n merical method of characteristics as presented Garder, Peaceman, and Pozzi. The model is tw dimensional, allows for dispersion or mixing of t fluid-fluid interface, and accounts for fluid densi differences. Porous-media properties are held co stant. The details of the computer program inclu ing a listing are included in this report. Several c culations were made with the model approximati laboratory-scale displacement experiments and actual field underground fresh water storage te These calculations indicate the potential usefuln of the mathematical model.
W69-01229

INDUCED ELECTRICAL POLARIZATION AN GROUNDWATER,
California University, Berkeley.
Rene Bodmer.
OWRR Project B-002-CAL, Rep No MT 67-1, G of Eng, Mar 1967. 101 p, 43 fig, 21 ref, 3 append

Descriptors: *Groundwater, Groundwa recharge, Resistivity, Clays, Geophysics, Electri studies, Gravels, Exploration, *Aquifers, Electri properties, Electric currents, Polarization, Elec cal impedance, Electric potential, Measuring struments, Subsurface investigations.
Identifiers: *Electrical prospecting, *Induc polarization method, Geophysical prospecting.

Conventional induced electrical polarization equipment was evaluated for investigating natural ground-water reservoirs in unconsolidated sediments. Clay horizons and other clay-bearing unconsolidated sediments are potential sources of induced polarization anomalies. Magnitudes of these anomalies are not expected to be large. However, if such anomalies may be detected above system noise, then the induced polarization method may be of value for in situ classification of unconsolidated sediments encountered in hydrological projects. One such project exists in Santa Clara County to determine whether or not induced polarization methods might be of value in potential recharge areas. Of 4 areas, only 2 yielded significant frequency effect anomalies and in each of these 2 the frequency effects were of order 3%. These anomalous frequency effects may be related to clayey gravels. The dipole-dipole array with spreads of 10 to 20 ft was typically used in the study.
W69-01235

BAND DIFFUSION WITH VARIABLE PARAMETERS ALONG FLOW,
Syracuse University, New York.
Wen-Hsiung Li.
J Eng Mech Div, Amer Soc Civ Eng, Proc Pap 4106, Vol 90, No EM5, pp 343-361, Oct 1964. 19 p, 8 fig, 14 ref, append.

Descriptors: *Dispersion, Flow, Porous media, Groundwater, Wastes, *Uniform flow, *Diffusion, Porous materials, *Engineering mechanics.

The diffusion equation with variable parameters along the flow can be solved when the diffused quantity is confined to a narrow band. Solutions are obtained for diffusion from a line source and a point source in nonuniform flows. The dispersion of a contaminant in nonuniform flows through porous media is studied. It is found that the dispersion across the streamlines can be estimated by using the solutions of diffusion from a line source and a point source in a uniform flow. (S. Mayer-FWPCA)
W69-01238

DISTRIBUTION AND OCCURRENCE OF NEW MEXICO'S THERMAL WATERS--A STATISTICAL SUMMARY,
New Mexico Institute of Mining and Technology State Bureau of Mines and Mineral Resources, Socorro.
W. K. Summers.
Tech Pap, 20th Annu Meeting New Mexico Geol Soc, Roswell, May 1966. 9 p.

Descriptors: *Thermal water, *Thermal springs, Groundwater, *Warm springs, Chemical analysis, Temperature, Aquifers, pH, Igneous rocks, Geothermal studies, *New Mexico.

Of 67 areas in New Mexico reported to discharge ground water at temperatures of 90 deg or higher, 46 have been substantiated in the field, 10 do not exist at the locations reported or have lesser temperatures. Data for 46 areas that have been field checked show that (1) thermal waters occur in the western half of the State, primarily in Rio Grande and Gila-San Francisco drainage basins; (2) only 16 areas have been discovered by wells whereas 30 areas were marked by springs; (3) water issues from rocks ranging from Precambrian to Cenozoic age with Cenozoic rocks predominating; (4) waters are associated with igneous and sedimentary rocks in equal proportions; (5) water occurs primarily in areas of extensive volcanism and secondarily in fault zones; (6) water discharges from springs near streams but mostly at points well above river levels; (7) discharge may be from fractures directly from beneath a talus cover, or from alluvium or some combination (1 spring discharged from a tufa mound); (8) median pH is 7.4; mediam maximum temperature is about 105 deg F; median discharge of springs is 30.5 gpm and medium concentration for sodium, 146 ppm; magnesium, 4.55 ppm, potassium, 4.6 ppm, and lithium, 0.28 ppm. Most thermal waters have been used for some purpose, but only 18 are now being used.
W69-01239

GROUND WATER YIELDS IN THE RALEIGH QUADRANGLE,
North Carolina University, Chapel Hill.
Charles W. Welby.
Water Resour Res Inst Rep 8, Univ N Car, May 1968. 61 p, 7 fig, 15 ref, 6 append. OWRR Project A-009-NC.

Descriptors: Bibliographies, Forecasting, *Groundwater, Crystalline rocks, *Water yield, Probability, North Carolina, Pump testing, *Water wells.

Development of a method for comparing water yields from wells drilled in crystalline rocks as the basis of a probability study of well yields is reported. The method utilizes curves drawn from data collected during short-term pumping tests and is designed for use in crystalline rocks and in the absence of observation wells. All measurements are made on the pumped well. The method was developed to take into account the nature of ground water occurrence in the crystalline rocks of North Carolina piedmont, and in particular the Raleigh, North Carolina, area. The curves and the principles on which they are based permit prediction of probable yields from a given well at a variety of pumping rates.
W69-01252

POTENTIAL GROUND-WATER HYDROLOGIC CHARACTERISTICS AS DETERMINED BY ELECTRIC RESISTIVITY CRITERIA,
Rhode Island University, Kingston.
John J. Fisher.
Water Resour Center, Univ RI, Final Rep, June 1967. 24 p, 7 fig, 10 ref. OWRR Project A-008-RI.

Descriptors: Geophysics, Resistivity, *Aquifer characteristics, Aquicludes, Water table, Sediments, Rhode Island, Physical properties, *Groundwater, On-site data collections, Electrical conductance, *Glacial drift, *Aquifers.

Subsurface glacial deposits on Block Island, Rhode Island were studied in the field by induced electrical resistivity surveys to determine groundwater conditions. Vertical depth profiles (to 200 feet) were developed to show correlation between lithology, ground-water characteristics and conductance (reciprocal of resistivity). Depth to water table, zone of groundwater, and the presence of aquifers and aquicludes could be determined from the conductance data. The water table had high conductance values, ranging from .012-.015 mhos while aquifers in the zone of saturation were higher, ranging from .012-.024 mhos. In contrast, aquicludes were lower, ranging from .001-.007 mhos. The zone of soil moisture was intermediate in value, ranging from .009-.016 mhos. (Author)
W69-01259

RESSLER V GERLACH)NEGLIGENT WELL CONTAMINATION(.
State of Pennsylvania, Harrisburg.

189 Pa Super 192, 149 A 2d 158-160 (1959).

Descriptors: Drill holes, *Wells, *Pennsylvania, Judicial decisions, *Water pollution, Septic tanks, Water wells.
Identifiers: Negligent contamination.

Defendant sunk a 30 foot hole on his land, about 90 feet from a 34 foot well on Plaintiffs' neighboring land. The hole was sunk to facilitate drainage from septic tanks servicing defendant's apartment buildings. Thereafter water in plaintiffs' well became contaminated. Plaintiffs notified the defendant and he immediately filled the hole with dirt. The well water subsequently became usable for a period of one week, but later the well went dry. Evidence showed that plaintiffs' well was dug through two layers of rock; the hole sunk by defendant was approximately to the same depth but did not go through the rock. There is no evidence to show that the defendant was negligent. Every man has a right to the natural use and enjoyment of his land and if while lawfully using his land, without negligence or malice, an unavoidable loss occurs to his neighbor, it is damnum absque injuria. (Molica-Fla)
W69-01284

COMMONWEALTH DEP'T OF HIGHWAYS V SEBASTIAN)DIVERSION LOSS OF UNDERGROUND STREAM(.
State of Kentucky, Frankfort.

345 S W 2d 46-47 (Ct App Ky 1961).

Descriptors: Judicial decisions, *Kentucky, Diversion, Diversion losses, *Underground streams, Alteration of flow, *Springs, Watercourses (Legal), *Surface - groundwater relationships, Grassed waterways, Channel flow, Percolating water, Preferences (Water rights), State governments, Condemnation, Administrative agencies, Natural flow doctrine.

Plaintiffs sought damages against the Commonwealth of Kentucky, Department of Highways, for the drying up of two springs on their farm resulting from a diversion of the flow of water to the springs by construction of a highway. In Kentucky where underground waters flow in unknown and undefined channels the owner of land, when putting his land to legitimate use, is not liable to the owner of adjoining lands for injuries to wells or springs fed by the stream. In the case of underground currents flowing in known and defined channels the rights of the parties are the same as with respect to surface streams. The evidence for plaintiffs was that the course of an underground stream running from a neighbor's land across the highway right of way to the springs was identifiable and marked by a line of green grass which grew on the surface. The court held the evidence as to the existence of an underground stream flowing in a known and defined channel was properly submitted to the jury. (Smodish-Fla)
W69-01307

HYDROLOGICAL STUDY OF THE LATTON GROUND-WATER SOURCE,
Swindon Corp Water Department, Swindon, Wilts, Great Britain.
A. R. Burton.
J Inst Water Eng, Vol 22, No 4, pp 287-293, June 1968. 7 p, 2 fig.

Descriptors: Underground water storage, Percolation, Foreign projects, Water yield, Permeability, Water table, *Aquifers, Specific yield, Thiem test, *Groundwater flow, Groundwater recharge, Ground water, Hydrology, Drainage basins, Rainfall.
Identifiers: Groundwater management, Mathematical models, Water wells, Great Britain.

Investigations for developing a new source of ground water demonstrate the relationship between ground-water parameters and the reliability of a mathematical model for predicting groundwater levels. Past records show that rainfall, abstraction, and water level are interrelated. Estimates of ground-water yield are made by extrapolating past measurements. A mathematical model was developed, assuming that the piezometric surface within the radius of influence of a discharging well is dependent upon the: (1) mean flow rate from the discharging well, (2) sum of previous discharged quantities, and (3) sum of recharged quantities. Ground-water recharge is assumed to be solely from rain percolation. The mathematical model requires only elementary algebraic expressions for predicting ground-water levels. Aquifer properties may be estimated from coefficients used in the mathematical model. (USBR)
W69-01410

UNIVERSITY OF ILLINOIS - URBANA

A SINGLE-WELL METHOD FOR DETERMINING THE DIRECTION AND VELOCITY OF FLOW OF UNDERGROUND WATERS--RESULTS OF IN-THE-FIELD INVESTIGATIONS,
Institute of Nuclear Technology and Hydrogeological Enterprise, Cracow, Poland.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01411

AQUIFER AND MODELS,
U. S. Geological Survey, Albuquerque, N. Mex.
C. V. Theis.
Pap, Proc Ser No 4, Symp Amer Water Resour Assoc, San Francisco, Calif, pp 138-148, Nov 1967. 11 p, 6 fig, 9 ref.

Descriptors: *Aquifers, *Models, *Ground water, Dispersion, Hydraulic conductivity Permeability, Wells, Observation wells, *Groundwater flow, Anisotropy, Heterogeneity, Porous materials, Distribution, Homogeneity, Dyes, Hydrology.
Identifiers: *Groundwater movement, Transport phenomenon, *Hydrologic models, Fluorescent tracers, Flow distribution.

A new conceptual model containing the known heterogeneity of the natural aquifer is needed to explain transport phenomena in ground water. The difficult problem of making the 2 sides of the continuity equation consistent is discussed. Various phenomena that occur when considering horizontal flow in an elastic confined aquifer are described. Changing values of parameters common to horizontal and vertical flow are stated. A chart shows the movement and concentration of a fluorescein tracer in a very coarse and permeable aquifer at the Hanford AEC. The hydraulic conductivity in aquifers ranging from about 2 to 4300 gal/day/sq ft in the order they were encountered by the drill is given. Another chart shows the same beds arranged in order of increasing conductivity with the corresponding logarithms of the conductivities. The range of permeability in water-bearing formations is shown. A laboratory model showing lateral dispersion of water in a small model is described. (USBR)
W69-01443

LABORATORY EVALUATION OF SELECTED RADIOISOTOPES AS GROUND-WATER TRACERS,
Texas A and M Univ, College Station, Texas.
A. Ray Jennings, and Melvin C. Schroeder.
Water Resources Res, Vol 4, No 4, pp 829-838, Aug 1966. 10 p, 2 fig, 3 tab.

Descriptors: *Groundwater movement, Base flow, Aquifers, *Radioisotopes, *Tracers, *Tracking techniques, *Laboratory tests, Chelation, Distribution patterns, Ion exchange, Adsorption, On-site data collections, Velocity, Porosity, Radioactivity, Ions.
Identifiers: Elution, Exchange columns.

The determination of the rate and direction of ground-water flow with tracers provides knowledge that is useful in evaluating the water inventory of an aquifer. Antimony 121, cerium 141, chromium 51, indium 114, ruthenium 103, and strontium 85 in chelate form were tested in the laboratory. Distribution coefficients were determined for the chelated radioactive isotopes and for unchelated chromium 51 for chushed shale and limestone with calcium as the saturating ion by the batch-treatment procedure. These measurements could be used to predict the elution history of a tracer from an exchange column. Ghelated chromium 51 was found to be an adequate ground-water tracer. The average velocity of ground-water was equal to the sum of the tracer velocity plus the product of the tracer velocity, the distribution coefficient, and the bulk density of the aquifer divided by its effective porosity. (Affleck-Ariz)
W69-01491

FIELD OBSERVATIONS COMPARED WITH DUPUIT-FORCHHEIMER THEORY FOR MOUND HEIGHTS UNDER A RECHARGE BASIN,
Agricultural Research Service, Fresno, California.
W. C. Bianchi, and E. E. Haskell, Jr.
Water Resources Res, Vol 5, No 1, pp 1049-1057, 1968. 9 p, 4 fig, 5 tab.

Descriptors: *On-site tests, *Recharge, Groundwater recharge, *Groundwater basins, *Dupuit-Forchheimer theory, *Hydrographs, Theoretical analysis, Ponds, Mathematical models, Water spreading, Artificial recharge, Water table, Waste disposal, Aquifer characteristics, Equations, Vadose water, Boundaries (Surfaces).
Identifiers: Mounds, Groundwater mounds.

Using Dupuit-Forchheimer assumptions, the rising and falling hydrograph of a groundwater mound beneath the center of a square or circular recharge basin has been theoretically described. The study reported in this paper tested for general agreement between these theories and actual field observations taken at the center of two experimental recharge ponds. The study also attempted to weigh considerations of scale, measurement, and geologic reality as to their significance in the reliability of an idealized mathematical model for the rise and fall of a ground-water mound. In water spreading for artificial recharge or waste disposal, prediction of the position of the water table during and after spreading is of considerable operational importance. (Affleck-Ariz)
W69-01492

INVESTIGATIONS INTO THE UNIFORMITY OF RELATION BETWEEN GROUND WATER AND RAINFALL OVER PROLONGED PERIODS AND THE POSSIBILITY OF PREDICTING GROUND WATER LEVELS WITH SPECIAL CONSIDERATION OF DRY PERIODS,
J. Denner.
Dt Gewasserk Mitt, Vol 9, pp 73-85, 1965.

Descriptors: *Groundwater, *Rainfall-runoff relationships.
Identifiers: Calculations.

A report, including tabulated and graphical results, is given of extensive studies carried out in 6 German towns at varying intervals over a period of 54 years on the distribution of rainfall and run-off, effective precipitation and temperature and stream flow. The effect of these characteristics on the response of the water table and their relation to climatic changes are discussed; it was found that the water table tends to respond to rainfall in a characteristic pattern, making it possible to predict short-term changes in the ground-water level allowing for weather forecasts and dry weather periods. From these findings standard values for high medium low and very low rainfall are derived.
W69-01588

2G. Water in Soils

UNSATURATED FLOW IN DRAINAGE PROBLEMS,
Michigan State University, East Lansing.
R. J. Kunze.
OWRR Project A-003-MICH, Reprint, Amer Soc Civ Eng Proc, pp 40-45, Dec 1965. 3 p, 5 fig, 13 ref.

Descriptors: *Drainage, *Unsaturated flow, *Groundwater flow, Soil moisture, Hydraulic conductivity, *Flow, *Subsurface flow, Diffusivity, *Soil water movement.
Identifiers: Diffusion coefficient.

Differences and similarities in conductivity and diffusivity data curves along with the functional role of these 2 flow parameters are discussed. Soil-water diffusivity appears to be the more complete flow parameter for investigating internal drainage of soils. Diffusivities obtained with 2 different methods over a sizable moisture range are in relatively good agreement, but data indicate that the diffusivity is not only moisture-dependent but is affected by time-dependent changes of the soil-water system. The observed time-dependent effect is directly related to the applied head. For computing the moisture status in a draining soil profile by means of the finite-difference form of the flow equation, a precise knowledge of the moisture history, the transmission coefficient-head and the moisture content-head relationships is necessary.
W69-01237

AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN METEOROLOGICAL VARIABLES AND STREAMFLOW.
Rutgers University, New Brunswick, N. J. College of Agriculture and Environmental Science.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01249

SPATIAL VARIATION IN THE MOISTURE CONTENT OF SANDY SOILS UNDER PINE STANDS,
All-Union Institute of Forestry and Mechanization of Forestry, USSR.
N. A. Voronkov.
Soviet Soil Sci, Vol 10, pp 1337-1343, October 1967. 7 p, 2 fig, 3 tab.

Descriptors: Variability, *Arid climates, *Spatial distribution, *Moisture content, *Sands, Soil surfaces, Soil horizons, *Pine trees, Soil moisture, Meteoric water, Root zone, Rain water, Topsoil, Depth, Wetting.
Identifiers: *Sandy soils, Replications, Litter, Plots.

This article examined factors in spatial variation as well as influence of the latter on accuracy with which moisture content of sandy soils under pine stands could be determined. Variations in moisture content were determined at depths of 10-20, 40-50, and 140-150 cm. The amount of water retained by the litter was determined. There were different reasons for variations shown in the soil surface and deep horizons. Variation in moisture content of top soil horizons was due to uneven wetting, which was quite dependent on the thickness of the litter and the degree of moisture the day before it rained. In severely dried sandy soils, the reason for uneven wetting near the surface could have been the formation of a layer of saturated capillary-suspended moisture. In arid climates, such cases seemed to occur on open spaces under steppe vegetation and fallow where the top horizons would sometimes dry out below wilting moisture level. (Blecker-Ariz)
W69-01484

IMPROVEMENT OF SOIL MOISTURE IN THE CONVERSION OF CHAPARRAL TO GRASS,
California Univ, Riverside.
C. M. McKell, and J. R. Goodin.
Proc 9th Int Grassland Congr, Vol 1, pp 573-575, 1966. 4 p, 6 fig.

Descriptors: *Soil moisture, *Chaparral, *Grasses, Root zone, Vegetation effects, Moisture content, Rainfall, *Arid lands, Brush control, Planting management, Water loss, Ranges, *Water yield improvement, Wetting.
Identifiers: Overstory, Plots, Seedlings.

Experimental plots were established to follow soil moisture changes in the root zone of vegetation cover in southern California. The first site was on a northeast slope supporting chamise and oak. The second site was on north, south and east facing slopes and supported a cover of chamise and oak. At the first site, the 12 inch depth of soil showed the most erratic changes in moisture levels. Rapid wetting and drying cycles corresponded closely with occurring rainfall. A major factor in successful establishment of a new vegetation cover lies in moisture accumulation and conservation until the seedling is firmly enough established to draw upon

moisture reserves of a large soil volume. If native grasses are not present, removal of the overstory allows for an accumulation of soil moisture required for a successful program of range seeding. Correct timing with respect to rainfall and complete removal of the overstory are needed in arid areas in order to let native grasses make most efficient use of the moisture available to them. (Blecker-Ariz)
W69-01485

INFLUENCE OF EVAPORATION SUPPRESSANTS ON WATER MOVEMENT IN SOILS,
Adelaide Univ, Glen Osmond, South Australia, Waite Agricultural Research Institute, Dept of Agricultural Biochemistry.
J. W. Kijne.
Aust J Soil Res, Vol 6, No 1, pp 67-73, July 1968. 7 p, 1 fig, 2 tab.

Descriptors: *Alcohols, *Retardants, *Soil water movement, Soil amendments, *Diffusivity, Capillary action, *Evaporation control, Monomolecular films, Infiltration, Wetting, Bulk density, Air-earth interfaces.
Identifiers: Fatty alcohols, Hydrophobic properties.

A study was conducted to investigate the influence of fatty alcohols on the rate of water movement through unsaturated soil, and to compare the effect of these fatty alcohols with the effect of other soil amendments. The fatty alcohols and dodecylamine had a stronger influence on soil-water diffusivity throughout the whole range of soil-water contents than did krilium, polyvinyl alcohol and Carbowax. The capillary flow of water to the soil surface was markedly reduced when treated with fatty alcohols. Dodecylamine reduced the rate of infiltration into the soil. Heats of wetting of the treated soil samples indicated that penetration rate and diffusivity near saturation were reduced in accordance with the hydrophobic character of the absorbed compound. (Affleck-Ariz)
W69-01487

2H. Lakes

WATER QUALITY AND PRIMARY PRODUCTION OF SOUTH DAKOTA LAKES,
South Dakota State University, Brookings.
John G. Nickum, and Norman D. Schoenthal.
Water Resour Res, Tech Res Proj, Completion Rep, S Dak State Univ, Dec 1967. 7 p, 1 ref. OWRR Project A-002-SDak.

Descriptors: *Water quality, *South Dakota, *Lakes, *Reservoirs, Limnology, Biology, Chemistry, Water analysis, Soil-water plant relationships, Aquatic plants.

Physical, chemical, and biological aspects of 45 lakes in S. Dak. were studied from July 1965 to July 1967. Maximum water temperature at the surface reached 28 deg C. Most lakes exhibited continuous circulation except when ice covered. Thermocline formation was observed in 6. Light transmission was influenced by turbidity, and varied greatly, within and among the lakes. Dissolved oxygen concentrations ranged from near saturation to less than the recommended minimum for fish life. All lakes were basic ranging from a pH of 7.1 to 11.3. Specific conductance of lakes occupying open basins was lowest in the unglaciated area west of the Missouri River (70-590 micromhos at 25 C) and highest in Mankato drift of the Wisconsin ice age (330-1260 micromhos at 25 C). Concentrations of major anions and cations tended to follow patterns which were associated with major physical divisions of the state or various drift types of the Wisconsin ice age. Trace elements were found in most lakes studied. Those lakes which developed dense summer blooms of phytoplankton were usually dominated by the blue-green algae Aphanizomenon or Microcystis. The maximum concentration of Chlorophyll as observed was 19.1 mg/1. Chlorophyll concentrations were generally higher in lakes east of the Missouri River.
W69-01262

PRODUCTIVE CAPACITY OF NORTH AMERICAN LAKES AS RELATED TO THE QUANTITY AND TROPHIC LEVEL OF FISH, THE LAKE DIMENSIONS, AND THE WATER CHEMISTRY,
Dalhousie Univ, Halifax, Nova Scotia, Inst of Oceanography.
F. R. Hayes, and E. H. Anthony.
Trans Amer Fish Soc, Vol 93, pp 33-57, 1964. 5 p, 1 fig, 5 tab, 14 ref.

Descriptors: *Productivity, *Yield equations, *Secondary productivity, Eutrophication, Lake morphology, Comparative productivity, Regression analysis, Statistical models, Standing crop, Harvesting, Alkalinity, Fish types, Computers, Commercial fishing, Fishing, Census, Trophic level, Great Lakes.
Identifiers: Hayes Productivity Index.

A Productivity Index (PI) for lakes derived from catch or biomass of fish, is defined by regression, log PI=-0.236 + 0.000147a - 0.517b + 0.287c, where a = sq root of (100,000/area in sq km); b = log mean depth in m; c = log methyl orange alkalinity in ppm. Factors used in deriving regression include considerations of census method and trophic level of fish. T-test shows 3 slope constants in equation are highly significant. 10 alternative expressions for PI (using transformations of PI and functions of area, depth and alkalinity) resulted in coefficients of determination with range 0.301-0.665, as compared with 0.670 for best expression. Of this 67% in variability in PI for latter expression, 20% is due to areal function, 29% to depth, and 18% to alkalinity. Best equation yielded theoretical PI corresponding closely with observed PI in 41 lakes and lake groups. Ratio, observed PI/calculated PI, for variety of lakes or lake groups having various fisheries ranged from 0.43 for two Ontario lakes with trout angling to 3.73 for lake (Prince Edward Island) with pond fishery for small trout. Best value of ratio (0.91) was for L Ontario; 20 of 24 ratios reported fall within range 0.43-1.52.
W69-01398

STANDARD CORRELATIONS BETWEEN PELAGIC PHOTOSYNTHESIS AND LIGHT,
Uppsala Univ., Sweden. Inst. of Limnology.
Wilhelm Rodhe.
Mem Ist Ital Idrobiol, 18 Suppl, pp 367-381, 1965. 5 p, 8 fig, 1 tab, 9 ref.

Descriptors: *Photosynthesis, *Primary productivity, Light, Lakes, Oceans, Correlation analysis, Phytoplankton, Light penetration, Optical properties, Light intensity, Water properties, Mathematical models.
Identifiers: Transparency, Talling's model, Lake Tarfala, Lake Tornetrask, Sweden, Lapland, Lago di Varese, Lake Erken, Bodensee, Zurichsee, Worthersee, Grand Ploner See, Ossiacher See, Lago Maggiore, Le Leman.

Response of pelagic photosynthesis to vertical attenuation of light follows a general pattern, common to various types of lakes as well as to the sea. Based on Talling's model for the photosynthetic integral, and attempt is made to define quantitative standard correlations. These facilitate the assessment and interpretation of photic and non-photic effects upon primary production of phytoplankton. Data are presented for 12 lakes with Secchi disk transparencies of 1.7 to 13.7 m and with integral assimilation values (C) between 45 and 1600 mg carbon/sq m/day. The best relationship shows C to be the product of a parameter, optical depth at which light saturation of photosynthesis occurs, and maximal assimilation (B) in milligrams of carbon/cu m/day. Ratio of observed C to C calculated from above relationship gives a mean of unity, deviations from which do not exceed 6.7%. With a slight modification, relationship can also be used to approximate estimates of total photosynthesis in cases where only the optical properties of water and the maximal photosynthetic rate are known. This less exact relationship is shown to be C = (B) (A-prime), where A-prime is metric depth at which the most penetrating component of light is attenuated to 10%.
W69-01458

2I. Water in Plants

WATER LOSS THROUGH INTERCEPTION BY MIXED-OAK FORESTS IN RHODE ISLAND,
Rhode Island University, Kingston.
James H. Brown, Jr.
Water Resour Center, Univ RI, Completion Rep, June 1967. 4 p. OWRR Project A-001-RI.

Descriptors: *Interception, *Streamflow, *Canopy, Water loss, *Oak trees, *Throughfall, Deciduous forests, Rhode Island, Leaves.

Mixed-oak canopy was found to intercept 10.1% of rainfall received during a leafless period from February 1 to May 22, 1966, and 13.1% during the subsequent leaf period. Of the rainfall reaching the ground under the forest stands, throughfall amounted to 85.1% of rainfall received in the open during the leafless period, while stemflow amounted to 4.8%. In contrast, when leaves were present percentages were 83.3 and 3.6 for throughfall and stemflow, respectively. It was found that net precipitation during the leaf period was not influenced by size class of mixed-oak forest, at least within the range of size classes studied which included oak stands averaging 30, 40, and 50 feet in height. The same could be said for the leafless period except that stemflow yields differed under the three size classes. Large differences in stemflow were observed between different oak species. Differences were attributed to bark characteristics and branching habits. (Author)
W69-01260

STRUCTURE OF FOREST VEGETATION BORDERING THE SAYLORVILLE IMPOUNDMENT,
Iowa State University, Ames.
Roger Q. Landers, and Dana R. Sanders.
Iowa State Univ Sci Tech, Proj Completion Rep, Aug 1967. 27 p, 9 fig, 10 tab, 2 ref. OWRR Project B-006-Ia.

Descriptors: *Vegetation, Forests, Watershed management, *Slopes, Pre-impoundment, Surveys, Oak trees, Maple trees, Forest management.
Identifiers: Des Moines River (Iowa), *Saylorville Reservoir (Iowa).

Sites chosen in the Saylorville Reservoir area were studied from standpoints of classification, composition of slope forests, and preimpound-watershed description. Important canopy species in the majority of stands include elms, ironwood, and ash. On drier sites white oak and shagbark hickory are dominants, with important understory species of Ribes spp., Parthenocissus quinquefolia, and Xanthoxylum americanum. Red oak, black maple, and basswood are more abundant on mesic sites and characteristic understory species include Anemonella thalictroides, Parthenocissus quinquefolia, Hepatica acutiloba, Carex alursina, and Asarum canadense. The above 2 categories describe the majority of sites. Any number of tree species may be dominant in the canopy from site to site, and understory dominants also show this variation. In considering management of these slope forests, our hypothesis is that the great majority of slope forest species will not withstand periods of flooding. Changes in structure and composition of vegetation will occur. This results in a predominance of opportunistic species capable of withstanding the stresses of flooding but undesirable for recreational use or watershed protection.
W69-01264

STRUCTURAL CHARACTERISTICS OF BENTHIC ALGAL COMMUNITIES IN LABORATORY STREAMS,
Oregon State Univ, Corvallis.
C. David McIntire.
Ecol, Vol 49, No 3, pp 520-537, Late spring 1968. 18 p, 5 fig, 7 tab, 31 ref.

UNIVERSITY OF ILLINOIS - URBANA

Descriptors: *Laboratory tests, *Benthic flora, *Aquatic algae, *Biological communities, Streamflow, Currents (Water), Diatoms, Cyanophyta, Light intensity, Productivity.
Identifiers: *Autecology, Species diversity, Community structure.

Effects of light intensity and current velocity on species composition and ecology of benthic algal communities were examined in laboratory streams. Of 15 diatom taxa studied, only Melosira varians, Navicula radiosa and Meridion circulare were more abundant in streams receiving 700 ft-candles of light than in those at 150 ft-candles. Achnanthes exigua, A minutissima, Meridion circulare, Rhoicosphenia curvata and Navicula radiosa were indifferent to current velocity, which had a positive effect on quantity of Navicula cryptocephala, N minima, N seminulum, Nitzschia linearis, Achnanthes lanceolata, Synedra ulna, Gomphonema parvulum, G angustatum, Cocconeis placentula and lanceolate Nitzschia. Melosira varians was more abundant in standing water. Of six non-diatom taxa, Anabaena variabilis and Tribonema minor were more abundant in streams at higher light intensity and Phormidium retzii was more abundant in moving water than in standing. At a particular season, light intensity and current velocity conditions in laboratory streams allow establishment of an algal community with characteristic species composition, biomass, pigment concentration and increment of export. To understand productivity in such communities one needs knowledge of the autecologies of community constituents and of mechanisms regulating floristic diversity and species composition.
W69-01397

SEEDING ANNUALS AND PERENNIALS IN NATURAL DESERT RANGE,
Hebrew University of Jerusalem; Volcani Institute of Agricultural Research, Newe Ya'ar Experiment Station.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-01475

THE INFLUENCE OF GRAZING- AND CUTTING-TREATMENTS ON WATER USE UNDER PERMANENT PASTURES IN GERMANY,
Bonn Univ, Institut fur Pflanzenbau, Germany.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-01478

PHOTOSYNTHESIS AND RESPIRATION OF FOUR PASTURE GRASSES AS AFFECTED BY MOISTURE CONDITIONS AND SALINITY,
Florida Univ, Agricultural Experiment Station.
For primary bibliographic entry see Field 03C.
For abstract, see .
W69-01479

SOIL MOISTURE AVAILABILITY TO SOME MESIC AND SEMI-XERIC SPECIES,
Purdue Univ, Lafayette, Indiana; Universidade Rural do Estado de Minas Gerais, Vicosa, Minas Gerais, Brasil.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-01480

MOISTURE USE OF PASTURE PLANTS IN A DESERT ENVIRONMENT,
Volcani Institute of Agricultural Research, Rehovot, Israel; Hebrew University of Jerusalem.
N. H. Tadmor, O. P. Cohen, and L. Shanan.
Proc 10th Int Grassland Congr, pp 897-906, 1967. 10 p, 3 fig, 2 tab, 24 ref.

Descriptors: *Water requirements, Water utilization, Grazing, Crop response, *Vegetation establishment, Deserts, *Drought resistance, Arid lands, Evapotranspiration, Plants, Ranges, Surface runoff, Slopes, *Water spreading, Soil-water-plant relationships, Pasture management, *Soil moisture, Carrying capacity.
Identifiers: Israel, Perennials, Annuals, Negev Desert.

The paper summarized data on water requirements and drought resistance of seven range plants at Advat Desert Research Center in the Central Negev desert of Israel. It was shown that even in a 100 mm rainfall desert some of the most useful perennial and annual pasture plants may be established and maintained by exploiting surface runoff from desert slopes. Even under such extreme drought conditions some of the plants investigated gave high yields and were efficient water users, giving a performance comparable to that of irrigated forage crops. Water-spreading in the bottomlands seemed to be a feasible method for improving the overall desert range with regards to carrying capacity, season of use and nutritive potential. Differences in water use between plants were related to length of growing season and rooting depth. (Blecker-Ariz)
W69-01483

2J. Erosion and Sedimentation

THE EFFECT OF A PERMEABLE BED ON SEDIMENT MOTION,
Georgia Institute of Technology, Atlanta.
C. S. Martin.
Water Resour Center, June 1966. 67 p, 38 fig, 13 ref. OWRR Project B-004-Ga.

Descriptors: *Beds (Stream), *Sediment transport, *Porous media, *Seepage, *Earth-water interfaces, Hydraulic gradient, Permeability, Slope stability, Bottom sediments, Hydrodynamics, Beds under water, Sediment-water interfaces, Stream erosion, Degradation (Stream).

The seepage force on uniform, cohesionless bed particles (sand) that comprise the top layer of a stream bed was determined experimentally. Slope stability tests were conducted by directing water normal to the plane of the bed. Results of tests for which the water flowed vertically upward into a horizontal bed were the most conclusive. The seepage force on the grains forming the interface was found to be about one-half the seepage force on grains well within the bed. Tests were made on the erosion rate following incipient failure with the bed in a horizontal position and the flow directed vertically upward. The rate of erosion was correlated with the rate of seepage (hydraulic gradient). A hydraulic gradient corresponding to an extrapolated rate of erosion of zero was minus 3.2. The corresponding seepage force on grains at the interface is about one-third the seepage force well within the bed. The seepage force on uniform, cohesionless bed particles at the sand-water interface is correlated to be about one-third to one-half the seepage force on particles well within the bed.
W69-01266

ANALYSIS OF OVERLAND FLOW ON SHORT EROSION PLOTS,
Purdue Univ, Lafayette, Indiana.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01408

2K. Chemical Processes

INTERACTION BETWEEN ALUMINUM AND PHOSPHATE IN AQUEOUS SOLUTION,
Rutgers-the State Univ, New Brunswick, NJ, Dept of Soils and Crops.
Pa Ho Hsu.
Related to OWRR Project B-008-PA: 'Removal of Phosphate from Water by Aluminum and Iron', October, 1968. Advances in Chemistry Series, No. 73, pp. 115-127, 1968.

Descriptors: Hydrolysis of Al3+/hydroxy-aluminum polymers, Soluble aluminum phosphate complexes, Aluminum phosphate precipitates, Phosphate removal.

This report deals with the reaction mechanism between aluminum and phosphate. It was found that by adding NaOH to AlCl3 solutions the resultant solutions contained Al3+ ions and also positively charged hydroxy-aluminum polymers. The polymers and Al3+ ions yielded different reaction products with phosphate. Hydroxy-aluminum polymers were completely and immediately precipitated by phosphate at their isoelectric points. This precipitation is interpreted to be a simple 'neutralization' of the net positive charge of polymers by the phosphate anion. Al3+ formed soluble complexes with phosphate, no precipitate being observed up to a H2PO4/Al molar ratio of eight. In solutions which contain both polymers and Al3+, each reacted with phosphate separately, and the reation product will depend greatly on the nature of the aluminum originally present in the solution. (Author)
W69-01407

2L. Estuaries

PARTITIONING OF THE ESTUARINE ENVIRONMENT OF TWO SPECIES OF CANCER,
Rhode Island University, Graduate School of Oceanography.
For primary bibliographic entry see Field 06G.
For abstract, see .
W69-01241

CURRENT STUDIES IN PAMLICO RIVER AND ESTUARY OF NORTH CAROLINA,
North Carolina University, Chapel Hill.
Donald B. Horton, Edward J. Kueuzler, and William J. Woods.
Water Resour Res Inst, Univ N Car, July 1967. 21 p, 2 fig, 4 tab, 7 ref. OWRR Project A-014-NC.

Descriptors: *Dye releases, Tracers, *Estuaries, *Model studies, Tidal effects, River flow, Salinity, Stratified flow, Inflow, *Path of pollutants, Dispersion, Diffusion, Currents (Water), Diffusivity.
Identifiers: *Rhodamine B, *Flushing time.

Rhodamine B dye was released in the Pamlico River estuary during the summer of 1967. The movement and concentration of the dye was followed wow through cuvettes. The average net movement of the dye patch was 915 m per day downstream. This movement was compared to predicted water movements derived from a tidal prism model of estuarine flushing. Under low fresh water inflow conditions as existed at the time of dye insertion, the predicted average transport was only 213 m per day. The discrepancy was due to a combination of factors inherent in the application of the theoretical model: (1) Possible substantial errors in the estimation of fresh water inflow; (2) No independent estimation of wind transport; (3) Vertical variation in fresh water outflow. The theoretical model was used to estimate flushing under average waterflow conditions. Under these conditions corrections for vertical stratification were possible and substantial errors in the estimation for fresh water inflow were obviated. Flushing time was estimated to be 65 days for the entire length of the estuary. Although there was a discrepancy between observed and calculated salinities, diffusive salt flux could account for the differences. Independent water current determinations did fit the model results.
W69-01251

DELWARE ESTUARY COMPREHENSIVE STUDY PRELIMINARY REPORT AND FINDINGS.
Federal Water Pollution Control Admin., Phila., Pa.

July 1966, 113 pp, figs.

Descriptors: *Estuaries, Water quality, *Storm runoff, *Overflow, *Water pollution, *Sampling, *Biochemical oxygen demand.
Identifiers: *Combined sewers.

The Delaware river estuary - particularly the segment between Trenton and the Pennsylvania-Delaware state line below Wilmington - was studied from the points of view of municipal and industrial waste discharges, water quality and its improvement by five specific alternative objective sets, water use, costs and benefits of projected improvements, and guidelines for implementation. Stormwater overflow discharges (discussed on pp. 24, 61, 92) are considered esthetically objectionable, although in comparison with other waste input it does not constitute a large source of oxygen-demanding pollution of the estuary. A continuation of the reported stormwater sampling program is urged, and a demonstration project to counteract undesirable effects of combined sewer overflow is recommended.
W69-01522

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

GROUND WATER YIELDS IN THE RALEIGH QUADRANGLE,
North Carolina University, Chapel Hill.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-01252

LEGAL ASPECTS OF WEATHER MODIFICATION--SNOW PACK AUGMENTATION IN WYOMING,
Wyoming University, Laramie.
John M. Pierce.
Land Water Law Rev, Vol II, No 2, pp 273-319, 1967. 47 p, 167 ref. OWRR Project A-999-Wyo.

Descriptors: *Weather modification, *Legal aspects, Snowpacks, Water yield improvement, Snowmelt, Flow augmentation, *Developed waters, Water allocation (Policy), Water resources development, Cloud seeding, Water supply.

The article focuses on the legal problems of ownership, control and liability as they are related to snowpack augmentation. Snowpack augmentation is but a small segment of weather modification, other segments--fog, hail, rain--are briefly mentioned. A discussion and analysis of the very few cases and statutory enactments is included, as is a discussion of the various legal theories on which the ownership of clouds and moisture can be predicated. The allocation of any runoff which results from snowpack augmentation must be considered in light of documents presently controlling the allocation of water--as an example the Colorado River Compact is studied. The increased runoff resulting from snowpack augmentation may be viewed as imported or developed water, and cases dealing with both imported and developed waters are studied. Other aspects--the right to store increased runoff in existing facilities, the importer's right to use the natural channel and the liability of the weather modifier are also discussed. (Wing-Wyoming)
W69-01263

AN ACT...TO CONSERVE AND PROTECT WATER RESOURCES OF THE STATE: TO PROVIDE FOR CLASSIFYING OF ALL WATERWORKS, WASTEWATER WORKS AND INDUSTRIAL WASTEWATER WORKS...
Maryland Laws ch 430 (1967).

Descriptors: *Maryland, Legislation, Administrative agencies, Classification, Legal aspects, *Regulations, Waterworks, Waste water treatment, Industrial wastes.
Identifiers: *Certification, *Superintendants, Fines.

Section 406A was added to Article 43 of the Annotated Code of Maryland (1965 Replacement Volume), title 'Health', subtitle 'Water, Ice and Sewerage.' The Act provided for the classification of all water works, wastewater works and industrial wastewater works. It also required the examination and certification of all superintendants, the people in charge of the operation of the various waterworks. A governor appointed Board of Certification was established to implement the requirements. The State Department of Health and the State Department of Water Resources was directed to provide training to prepare superintendants for certification. A fine of $25 a day was established for any violation of the Act. (Sisserson-Fla)
W69-01319

SOIL MOISTURE AND TEMPERATURE CHANGES FOLLOWING SAGEBRUSH CONTROL,
Wyoming Univ., Laramie.
Herbert G. Fisser.
J Range Manage, Vol 21, No 5, pp 283-287, September 1968. 5 p, 7 fig.

Descriptors: *Temperature, *Soil moisture, *Sagebrush, *Productivity, *Grasslands, Arid climates, Water loss, Seimarid climates, Seasonal, Soil temperature, Shrubs, Moisture availability, Brush control, Wyoming, Vegetation effects, Crop response, Grazing, Rainfall disposition, Soil-water-plant relationships.
Identifiers: Herbage, *Mesic.

A study was conducted in western Wyoming to evaluate soil moisture, soil temperature and herbage production changes following chemical control and non-grazing treatments of big sagebrush. Two sites, one a mesic grassland and the other an arid shrub type were studied. Soil moisture recharge during the spring period at the mesic site was much greater under the non-use treatment than in the grazed area. Soil moisture withdrawal was similar at both the arid and mesic sites. Variation of seasonal moisture levels combined for all depths and years showed a much greater variation at the mesic site than at the arid site. At the mesic site, grasses utilized almost all available moisture in the upper two feet of the soil. That which was not utilized moved downward to accumulate in the 36-60 inch zone from which sagebrush draws its major water supply. (Blecker-Ariz)
W69-01469

TOPOGRAPHIC MODIFICATION OF LAND FOR MOISTURE ENTRAPMENT,
Nebraska Univ, Lincoln.
H. D. Wittmuss.
Trans Amer Soc Agr Eng, Vol 11, No 3, pp 384, May-June 1968. 1 p.

Descriptors: *Topography, Moisture content, *Runoff, Semiarid climates, *Land forming, Terracing, Land management, Great Plains, Soil moisture, Soil management.
Identifiers: Bench terraces.

Conservation bench terraces provide a more effective means of moisture conservation than the practice of summer fallow in semi-arid regions of the United States. Graded terraces allow water to run off when heavy rainfall occurs, whereas level terraces with closed ends concentrate runoff water in the terrace channel where deep percolation occurs. Runoff losses from graded terraces averaged 1.2 inches per year during the 11-year study period. Results indicated that substantial yield increases could be expected by leveling the terrace channel which would alleviate deep water ponding in the terrace channel and increase efficiency of water use by crops. Level or graded terraces could be employed in arid climates to utilize soil and water resources more effectively. (Blecker-Ariz)
W69-01472

PROBLEMS OF LAND MANAGEMENT IN THE VARIOUS PHREATOPHYTE ZONES,
Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.
Jerome S. Horton.
66-3 Meeting of the Pacific Southwest Interagency Committee, Albuquerque, New Mexico, August 30, 1966. 6 p.

Descriptors: Arid climates, *Land management, *Phreatophytes, *Tamarisk, Transpiration, *Water yield improvement, Ecology, *Brush control, Intermittent streams, Perennial streams, Vegetation effects, Water temperature, Flood plains, Transpiration, Playas, Riparian plants.
Identifiers: Shade.

Land occupied by phreatophytes presents a problem not solely in plant eradication, but also in land management in order to bring about proper use of all resources inherent in the West. Tamarisk or saltcedar, which is a very common phreatophyte, is discussed with respect to origin, ecology and position as an aggressive phreatophyte in the West. Cutting of vegetation along perennial and intermittent streams in the Southwest will have a compounding effect since the removal of shade will increase water temperature, which will create greater evaporation losses that may not be compensated in full by reduced transpiration from the smaller number of trees. (Blecker-Ariz)
W69-01473

THE IMPROVEMENT OF DESERT RANGES IN UZBEKISTAN,
All-Union Research Institute of Darakul Sheep Husbandry, Samarkand, USSR.
I. Sh Shamsoutdinov.
Proc 10th Int Grassland Congr, pp 960-962, 1967. 3 p.

Descriptors: *Sagebrush, Arid lands, Soil moisture, *Shelterbelts, Deserts, *Ranges, *Vegetation establishment, Forages, Winter, Productivity.
Identifiers: Uzbekistan, Saksaul, Fodder, Ephemer.

The planting of black saksaul shelter belts in Sagebrush-ephemer deserts together with the establishment of fall-winter ranges in foot-hill deserts and cultivation of fodder crops, without irrigation, to provide feed on ranges in winter are ways that are used to conserve moisture on desert ranges. Black saksaul shelter belts act as windbreaks and snow accumulators. The nearby humidity level is increased and as a result a milder and more stable microclimate is created which promotes normal growth and development of range plants. (Blecker-Ariz)
W69-01476

SOIL MOISTURE AVAILABILITY TO SOME MESIC AND SEMI-XERIC SPECIES,
Purdue Univ, Lafayette, Indiana; Universidade Rural do Estado de Minas Gerais, Vicosa, Minas Gerais, Brasil.
D. J. Sykes.
Proc 9th Int Grassland Congr, Vol 1, pp 399-402, 1966. 4 p, 3 fig, 1 tab.

Descriptors: Arid climates, *Xerophytes, *Soil moisture, *Moisture tension, Capillary conductivity, Soil-water-plant relationships, *Moisture availability, *Wilting point, Field capacity, Osmotic pressure, Turgidity, Growth chambers, Absorption, Environmental effects.

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Identifiers: Mesic, Turgor pressure, Crawl.

Soil moisture tensions at the permanent wilting percentage were determined with five plant species on soils with high and low moisture conductivity. Results ranged from 39 atmospheres with Agropyron intermedium to seven atmospheres with Helianthus annuus and showed highly significant differences between soils, species and environmental conditioning. The major limiting factor determining the permanent wilting of plants was the rate of moisture contrast to the 15 atmosphere concept. Xeric species or plants hardened by environmental conditioning may withstand high soil moisture tensions while soil moisture moves slowly to their roots. Such plants may have low permanent wilting percentages and may take up and utilize water held at tension considerably above 15 atmospheres. This condition can occur in many arid parts of the world. (Blecker-Ariz)
W69-01480

ECONOMIC FACTORS IN THE IMPROVEMENT OF ARID AND SEMI-ARID GRASSLANDS,
Forest Service, Division of Range Management.
L. Rader.
Proc 9th Int Grassland Congr, Vol 2, pp 1593-1597, 1966. 5 p, 1 tab.

Descriptors: *Arid climates, *Economic feasibility, *Grasslands, Range management, *Sagebrush, Droughts, *Semiarid climates, Productivity, Cost-benefit analysis, Brush control, Carrying capacity, Livestock, Grazing, Vegetation regrowth, Pasture management.

Range improvement and management practices can be used to increase productivity of arid and semi-arid grazing lands. An analysis of factors influencing costs and returns from range improvement, using removal of sagebrush as an example, suggests that actual costs of improvement are related to the method of improvement, site conditions and size of the area improved. Sagebrush grows in areas where precipitation is low and where there are large fluctuations in annual rainfall with frequent and often prolonged droughts. With removal of sagebrush, more water becomes available for the growth of grass. This in turn will increase range carrying capacity and result in increased livestock production. Examples of three possible situations and two levels of improvement costs are given. They illustrate that improvement of sagebrush ranges may be profitable on better sites and that relatively small investments may be justified on sites where potential capacity is low. (Blecker-Ariz)
W69-01482

PHREATOPHYTES-WATER USE AND POTENTIAL WATER SAVINGS,
Agricultural Research Service, Boise, Idaho.
Dean C. Muckel.
J Irrig and Drain Div ASCE, Vol 92, No IR 4, Proc Paper 5033, pp 27-34, Dec 1966. 8 p, 2 fig, 2 tab.

Descriptors: *Phreatophytes, *Water utilization, *Water conservation, *Evapotranspiration, Arid climates, Semiarid climates, *Brush control, Tamarisk, Water table, Plant populations.
Identifiers: Greasewood.

Salvage of water consumed by phreatophytes of low economical value had long been considered, and increasing emphasis is being placed on this source of water in the arid and semi-arid west. Evaluation of potential savings in water use requires that water use be estimated under present and modified conditions. The problems of measuring evapotranspiration by phreatophytes were examined. Salvage of water now being used is difficult because the plants are persistent and difficult to eradicate. Three methods of salvage were listed. The eradication of both salt cedar and greasewood were discussed. (Affleck-Ariz)
W69-01488

3C. Use of Water of Impaired Quality

PHOTOSYNTHESIS AND RESPIRATION OF FOUR PASTURE GRASSES AS AFFECTED BY MOISTURE CONDITIONS AND SALINITY,
Florida Univ, Agricultural Experiment Station.
Vincent N. Schroder.
Proc 10th Int Grassland Congr, pp 181-184, 1967. 4 p, 4 tab.

Descriptors: *Pastures, *Grasses, *Soil moisture, Salinity, Photosynthesis, Respiration, *Plant growth, *Salt tolerance, Flooding, Irrigation effects, Water injury, Soil-water-plant relationships.

A study was designed to determine tolerance of several widely grown pasture grasses to salinity and flooding and to study the effect on rates of photosynthesis, respiration, and overall growth. The four warm-season grasses were: Pangola grass, Pensacola Bahia grass, Coastal Bermuda grass and St. Augustine grass. All four species were tolerant to levels of sodium chloride as high as 4500 ppm in the irrigation water. Continuous flooding for a period of 36 days was not harmful. Bermuda and St Augustine grass were the most tolerant of high levels of salt. Chemical data suggested that Bermuda grass does not absorb sodium as readily as the other grasses and that St. Augustine grass absorbed and could tolerate higher levels within the plant. Since salinity is usually considered to affect growth in a large measure by imposing a water stress on plants, data in the study could be used in arid regions where water stress is an important aspect of plant growth. (Blecker-Ariz)
W69-01479

SPRINKLER IRRIGATION WITH HIGH SALT-CONTENT WATER,
Arizona Univ, Tucson.
C. D. Busch, and F. Turner, Jr.
Trans ASCE, Vol 10, No 4, pp 494-496, 1967. 3 p, 2 fig, 5 tab.

Descriptors: Irrigation systems, Irrigation effects, *Saline water, *Sprinkler irrigation, *Cotton, Diurnal, Crop response, Water quality, Water loss, Water requirements, Toxicity, Leaves, Evaporation, Furrow irrigation, Surface irrigation.

A study was conducted in Safford, Arizona, to determine the effects of saline water sprinkling on the yield of cotton. Besides comparing day versus night sprinkling, the study included comparisons of flat and furrowed soil surface on both long staple (S-2) and short staple (1517D) varieties of cotton. The two-year study of sprinkling cotton with saline (3,160 ppm) water showed that the higher daytime evaporation losses from sprinkling markedly affect both the sodium content in plant leaves and the crop yield. The normal diurnal fluctuations plus problems of sprinkler adjustment suggested that night sprinkling presented a reasonable procedure for sprinkler irrigation with water classified as poor in quality. (Affleck-Ariz)
W69-01489

3D. Conservation in Domestic and Municipal Use

PERIMETER DRAINAGE TO PROTECT URBAN LANDS,
R. T. Chuck.
ASCE Proc, J Urban Planning Devel Div, Vol 93, No UP1, Paper 5055 pp 1-12, Jan 1967.

Descriptors: *Drainage systems, *Planning.
Identifiers: *Urban drainage, Hawaii.

Perimeter drainage is challenging approach for providing drainage protection to urban lands; essential in its concept is consideration of alternative uses of existing natural water courses; by using man-made waterways to supplement, alter, or entirely eliminate existing natural drainage pattern, perimeter drainage affords means of providing adequate protection to urban lands, while preserving and enhancing their economic and aesthetic values; successful experience in Hawaii suggests that perimeter drainage has considerable merit in urban planning and development and should be given more serious attention in well-planned urban lands.
W69-01565

3E. Conservation in Industry

WATER CONSERVATION IN FOOD PROCESSING PLANTS,
Maine University, Orono.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01265

3F. Conservation in Agriculture

OPTIMAL TIMING OF IRRIGATION,
California Univ., Riverside; Nevada Univ., Reno.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01214

AN ACT AMENDING THE ACT OF MAY 15, 1945)PL 547(, ENTITLED, AS AMENDED, 'AN ACT RELATING TO SOIL CONSERVATION AND SOIL EROSION...',
State of Pennsylvania, Harrisburg.

Laws of Penn 1967, Act 382.

Descriptors: *Pennsylvania, Legislation, *Administrative agencies, State governments, Soil conservation, Water conservation, Adoption of practices, Erosion control, Project purposes, Local government, Project planning, Erosion control, *Standards, Administration, Social aspects, Management, Soil management, Water management.

A state soil and water conservation commission is established, consisting of four farmers and two urban members in addition to state administrative officers and the dean of the state college of agriculture. Commission duties include coordination of soil and water conservation programs among the various districts herein described, extension of government aid to land and water management programs and to private lands, and creation of soil and water conservation districts when the various county commissioners and rural landowners favor such action. Membership in the board of the county water and soil conservation districts is governed. Qualifications of and terms of office for the members of both the state commission and the various county commissions are detailed. (Blunt-Fla)
W69-01308

WATER REQUIREMENTS FOR INCREASED ARID LAND PRODUCTIVITY,
For primary bibliographic entry see Field 02D.
For abstract, see .
W69-01470

WATER IMPORT SYSTEMS FOR ARID LAND DEVELOPMENT.
Ralph M. Parsons Co., Los Angeles, Calif.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01471

SEEDING ANNUALS AND PERENNIALS IN NATURAL DESERT RANGE,
Hebrew University of Jerusalem; Volcani Institute of Agricultural Research, Newe Ya'ar Experiment Station.
N. H. Tadmor, M. Evenari, and J. Katznelson.

J of Range Manage, Vol 21, No 5, pp 330-331, September 1968. 2 p, 1 tab.

Descriptors: Rainfall, *Planting management, *Deserts, Arid climates, Vegetation regrowth, *Water spreading, *Plant growth, *Pasture management, Ranges, Moisture deficit.
Identifiers: Israel, Negev Desert, *Annuals, *Perennials.

An investigation was conducted in 1960-61 to study range seeding under desert conditions at the Avdat Desert Research Center in the central Negev of Israel. Seeding of pasture plants in a 78-mm rainfall desert resulted in complete failure of all perennials to establish themselves. Annuals, in spite of stunted growth, completed their life cycle and produced seed. Water-spreading was a prerequisite for successful establishment of perennial pasture plants under desert conditions. (Blecker-Ariz)
W69-01475

THE BREEDING OF SPINELESS CACTUS)OPUNTIA SPP(AS A DROUGHT RESISTANT FODDER CROP,
Research Institute of the Karoo Region, Middelburg, C P, Republic of South Africa.
G. C. de Kock.
Proc 9th Int Grassland Congr, Vol 2, pp 1459-1460, 1966. 2 p, 1 tab.

Descriptors: *Plant breeding, *Cacti, *Drought resistance, Plant growth, Arid climates, Insect resistance, Semiarid climates, Seed treatment, Irradiation, Gamma rays, Crop response, Germination, Genetics, Forages.
Identifiers: Cross breeding, Nutritive value, Succulents, Spineless cactus, Republic of South Africa.

The Republic of South Africa has a breeding program which aims at the improvement of the spineless cactus (Opuntia spp) with respect to drought resistance, fodder yield, palatability, nutritive value and insect resistance. Variations were obtained by cross-breeding and treating air dry seed of different spineless cactus cultivars with gamma rays. With the considerable variation obtained by the propagation of seed, gamma irradiation of seed and the treatment of seed with chemicals, it is possible to improve the cross-pollinated drought resistant spineless cactus fodder plant by selection and cross-breeding. (Blecker-Ariz)
W69-01477

THE INFLUENCE OF GRAZING- AND CUTTING-TREATMENTS ON WATER USE UNDER PERMANENT PASTURES IN GERMANY,
Bonn Univ, Institut fur Pflanzenbau, Germany.
H. G. Kmoch.
Proc 10th Int Grassland Congr, pp 137-140, 1967. 4 p, 1 fig, 3 tab.

Descriptors: Grazing, Arid climates, *Pasture management, Pastures, *Soil moisture, *Plant growth, Nitrogen, *Cutting management, *Water utilization, Moisture uptake, Growth stages, Leaves, Root systems, Fertilizers, Rainfall.
Identifiers: *West Germany, Stems, Neutron Scattering Method.

A grazing experiment was developed to compare long-term effects of constant grazing or cutting at different stages of plant growth. Soil moisture was measured by the Neutron Scattering Method. The differences between stem-stage and leaf-stage decreased in dry years compared with wet years, as far as the first cutting was concerned. In arid parts of the world, the reduction in vigor of roots, and the subsequent diminished water uptake from the subsoil, was taken into consideration as a cause of overgrazing. It was hard to explain why dry periods of equal length and intensity sometimes brought great hazards to pasture production and sometimes did not. Nitrogen fertilization was considered in connection with its effect on the increased depth and extension of the root system which could help to overcome dry periods. (Blecker-Ariz)
W69-01478

THE EFFECT OF SOIL MOISTURE REGIME AND NITROGEN APPLICATION ON THE PRODUCTION OF A PERRENNIAL PASTURE MIXTURE,
Department of Agriculture, South Australia, Australia.
P. Judd.
Proc 9th Int Grassland Congr, Vol 2, pp 1191-1197, 1966. 7 p, 5 tab, 21 ref.

Descriptors: *Soil moisture, *Arid climates, *Nitrogen, *Pastures, Fertilizers, Moisture tension, Clovers, Perennial ryegrass, *Moisture stress, Water utilization, Pasture management, Rates of application, Crop response, Grasses, Irrigation effects, Productivity.
Identifiers: Dry matter, Quadrats.

An experiment was established at the Milang Irrigation Research Center in South Australia to gain better understanding of the use of nitrogen and water and their effects on pasture yield, botanical composition and general economics of production. Three soil moisture regimes (30 cm, 20 cm and 12 cm Hg tension) and three levels of nitrogen application (0, 98.4 and 295.2 lb N per acre) were applied during the summer to a perennial pasture. Clover was highly sensitive to moisture stress and was therefore at a competitive disadvantage as soil moisture stress increased. Ryegrass showed no response without nitrogen application. Total production and production per unit of water applied increased as soil moisture stress decreased. Fertilizer nitrogen, through the medium of grass production, increased the yield per unit of water applied and this compensated for moisture stress. The plants on a well fertilized arid range will make the most efficient use of the moisture available to them. (Blecker-Ariz)
W69-01481

THE MANAGEMENT AND UTILIZATION OF SPINELESS CACTUS)OPUNTIA SPP(,
Research Institute of the Karoo Region, Middleburg, C P, Republic of South Africa.
G. C. de Kock.
Proc 9th Int Grassland Congr, Vol 2, pp 1471-1474, 1966. 4 p, 2 tab.

Descriptors: *Cacti, Semiarid climates, Arid climates, *Drought resistance, Droughts, Grazing, Contour farming, *Browse utilization, Water conservation, Soil conservation, *Forages, Vegetation establishment, *Planting management, Nutrients.
Identifiers: Succulents, Spineless cactus, Saltbush, Fodder, Republic of South Africa.

In arid regions of the Republic of South Africa, drought resistant fodder crops such as spineless cactus and Oldman Saltbush have been planted extensively and used as a source of feed and water reserves during droughts. Spineless cactus yields considerable quantities of succulent plant material under comparatively unfavorable climatic conditions and retains its succulence even during droughts. When planting is done on the contour, the plants serve as a wind break, reduce runoff and this way conserve both soil and water. Spineless cactus cultivars Monterey, Chico, and Robusta were used in the trials. (Blecker-Ariz)
W69-01486

EFFECT OF DRYLAND LEVELING ON SOIL MOISTURE STORAGE AND GRAIN SORGHUM YIELD,
Agricultural Research Service, Manhattan, Kansas.
Leon Lyles.
Trans ASAE, Vol 10, No 4, pp 523-525, 1967. 3 p, 4 tab.

Descriptors: *Land forming, *Dry farming, Growth stages, *Soil moisture, Water utilization, Texas, *Water storage, Fallowing, Runoff, *Sorghum, Topography, Crop response, Rainfall-runoff relationships, Water table, Surface runoff, Sampling.
Identifiers: *Rio Grande Valley (Texas).

In the Lower Rio Grande Valley of Texas effects of leveling non-irrigated land on stored soil moisture and hybrid grain-sorghum were studied for three years at three paired sites. Even though leveled fields showed more stored moisture than non-leveled fields following runoff-producing rains in the fallow season, these differences largely disappeared by seeding time. At seeding time only about 6 percent of fallow-season rainfall was stored in the 6 ft soil profile. Average test period grain yields showed slight advantages of 50, 50, and 80 lbs per acre in favor of the leveled fields over non-leveled fields of sites 1, 2, and 3 respectively. Other possible advantages of non-irrigated land leveling were noted. (Affleck-Ariz)
W69-01490

CONSERVATION BENCH TERRACES IN TEXAS,
Agricultural Research Service, Bushland, Texas.
Victor L. Hauser.
Trans ASAE, Vol 11, No 3, pp 385-386, 392, 1968. 3 p, 3 fig, 3 tab.

Descriptors: *Water conservation, *Dry farming, *Bench leveling, *Terracing, Texas, *Erosion control, Fine-textured soils, Soil water, Runoff, Crop response, Watershed management, Water storage, Wheat, Sorghum.
Identifiers: Water erosion, *Conservation bench terraces.

The conservation bench terrace is a structure designed to conserve runoff water for crop use on dryland and to control water erosion. Ten years of research with farm-size fields at Bushland, Texas showed conservation bench terraces to be an improved terrace system for the fine textured soils of the Southern Plains. Bench terraces increased total crop production from a farm-size unity 1.5 times the production achieved by level terraces. Conservation benches stored more water than a bench-leveled area and the same amount as level terraced fields after eleven months of fallow. (Affleck-Ariz)
W69-01493

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on THE Surface

DISCUSSION OF AQUEDUCT CAPACITY UNDER AN OPTIMUM BENEFIT POLICY,
Illinois Univ., Urbana.
S. Ramaseshan.
Amer Soc Civil Eng Proc, Vol 88, No IR2, pp 97-100, June 1962.

Descriptors: *Aqueducts, Benefits, Digital computers, Distribution systems, *Economic efficiency, *Linear programming, Dynamic programming, Monthly, Multiple-purpose, Optimization, Reservoir design, Reservoir operation, Seasonal, Water distribution (Applied).

A linear programming model is presented which takes into account more facets of the aqueduct sizing problem than Hall's dynamic programming model. Monthly variations in inflow and outflow, a curvilinear cost function for the channel and reservoir and convex benefit function are used in the model. No overyear storage or overflow in a normal year is assumed. Physical constraints are placed upon the aqueduct flows, total outflows and the net storage in each time period. For 3 aqueduct sections, 3 ranges of benefit functions and 12 months, there are 276 equations with 274 slack

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variables and 108 real variables. A trial and error solution is required. Values for the flow in the 3 sections can be chosen by random sampling, systematic sampling or by the single factor method. It is suggested that by analysis of the model for different reservoir sizes, the optimum storage capacity can be determined. (Gysi-Cornell)
W69-01206

PRODUCT-MIX ALTERNATIVES: FLOOD CONTROL, ELECTRIC POWER, AND IRRIGATION,
Stanford Univ., Palo Alto, Calif.
Alan S. Manne.
Int Econ Rev, Vol 3, No 1, pp 30-59, Jan 1962. 8 fig, 8 tab, 19 ref, 1 append.

Descriptors: *Linear programming, Markov processes, *Multi-purpose reservoirs, Economic efficiency, Optimization, Flood control, Electric power rates, Irrigation.
Identifiers: Economic trade offs.

Stochastic linear programming was used to determine the optimal operating policy of a single reservoir used for flood control, electric power, and irrigation. The probability of inflows into the reservoir were assumed to be uncorrelated. The model was assumed to have an infinite horizon. The objective was to maximize expected annual benefits subject to certain constraints of statistical equilibrium. A hypothetical example was solved. The conclusion was that the higher the level of storage capacity reserved for flood protection during the wet season, the lower became the expected hydroelectric benefits. Results were presented and analyzed in the form of product-mix curves and tables. An intrepretation of the dual variables was presented. Modifications were suggested in the model to account for head-height effects and benefits from irrigation. Comparison between the probabilistic and deterministic calculations are given in an appendix. (Gablinger-Cornell)
W69-01208

THE USE OF STORAGE WATER IN A HYDROELECTRIC SYSTEM,
Massachusetts Institute of Technology, Cambridge.
John D. C. Little.
Oper Res Soc Amer J, Vol 3, No 2, pp 187-197, May 1955. 2 fig, 1 tab, 4 ref.

Descriptors: *Dynamic programming, Reservoir operation, *Hydroelectric power, Markov processes, Computer programs, Mathematical models, Optimization, Operating costs.
Identifiers: Grand Coulee Dam, Columbia River.

Stochastic dynamic programming was used to find operating rules of a reservoir used for hydroelectric production. The objective was to minimize the expected yearly cost. The state variables were current reservoir level and inflows into the reservoir in the preceding interval, the decision variables were the releases from the reservoir, and the stages were the time intervals. Probabilities of inflow were assumed to conform to a simple Markov process. The recursive relation was developed, and a mathematical model of the hydroelectric cost was presented. An example using data from the Grand Coulee Dam on the Columbia River was solved. The system was then operated with historical flow record as input and analyzed. The minima found were sometimes true minima and sometimes corner minima. (Gablinger-Cornell)
W69-01209

STATISTICAL ANALYSIS OF THE RESERVOIR STORAGE - YIELD RELATION.
Harvard Univ., Cambridge, Mass., Harvard Water Resources Group.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01210

THE OPTIMIZATION OF SINGLE-PURPOSE RESERVOIR DESIGN WITH THE APPLICATION OF DYNAMIC PROGRAMMING TO SYNTHETIC HYDROLOGY SAMPLES,
California Univ., Los Angeles.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01222

PLANNING FLOOD CONTROL MEASURES BY DIGITAL COMPUTER,
University of Kentucky, Lexington.
James N. Cline.
Res Rep No 11, Univ Kentucky, 1968. 313 p, 6 fig, 35 tab, 38 ref. OWRR Project A-001-Ky.

Descriptors: *Computer programs, Computers, Computer models, *Flood control, Analysis, Planning, Economics, Land use, Flood, Flood proofing, Flood protection, Design flood, Costs, Channel improvement, Hydrographs.

The purpose of this study was to develop adequate guidelines for using a pair of digital computer programs known as the University of Kentucky Flood Control Planning Programs to ease the computational burden of evaluating specific flood control situations. Program II determines the economically optimum combination of channel improvement, land use restriction, and flood proofing for flood damage abatement. Program III also incorporates reservoir storage into the planning process. The Programs are not intended to provide a finished design but rather to select the optimum combination of flood control measures and residual flooding with regard to both time and space. Application of Computer Programs to flood control planning is guided by presenting a general description of the application process and a detailed description of the input required and the output produced by the Planning Programs. Input was developed and results interpreted to determine the optimum flood control plan for the upper reaches of the North Fork of the Kentucky River near Hazard, Kentucky.
W69-01268

BEY V WRIGHT PLACE, INC)DAMAGES FOR WATER DISCHARGE ONTO PLAINTIFF'S LAND(.
State of Ohio, Columbus.

160 N E 2d 378-383 (Ct App Ohio 1956) 6 p.

Descriptors: Judicial decisions, *Ohio, Damages, Discharge (Water), Rainfall-runoff relationships, *Runoff, Surface waters, Ditches, Channels, Natural streams, *Sewage, Watercourses (Legal), Wells, Streams, Beds, Banks, Drainage, Riparian rights.

Action was brought for damages resulting from additional waters discharged onto plaintiffs' land by the defendants. The trial court ruled in favor of the plaintiffs, and the court of appeals affirmed. The owner of lower land must accept natural surface drainage from higher land. However, where surface water, when it rained, ran from higher land of the defendants over lower lands of the plaintiffs and then into a ditch, but there was never a watercourse, natural waterway, or other defined channel, the plaintiffs were not required to accept from the defendants' higher land additional water which had been pumped from deep wells, then used for toilets, washrooms, restaurant, and other business uses. This additional water was not surface water and the defendants were liable for damages caused by the additional waters on the land of the plaintiffs. One may not obtain by prescription, or otherwise than by purchase, a right to cast sewage on the lands of another without his consent. (Watson-Fla)
W69-01276

LINCOLN PARK AMUSEMENT CO V TOWN OF WESTPORT)ACTION BY PROPERTY OWNER TO COMPEL TOWN TO REOPEN CULVERT(.
State of Massachusetts, Boston.

159 N E 2d 68-70 (Mass 1959) 3 p.

Descriptors: Judicial decisions, *Massachusetts, *Culverts, Roads, Surface drainage, *Natural streams, Ponds, Rivers, Tributaries, Effluents, Discharge (Water), Streams, Runoff, Flow, Riparian rights, Streamflow, Obstruction to flow.

This was an action by an amusement company to compel the town to reopen and maintain a culvert in good condition. The Supreme Court held that the finding by a master that water had flowed from the plaintiff's pond through the culvert to a tributary of a river from 1908 to 1954 supported the conclusion that the culvert had become a natural watercourse which the town had a duty to keep open. Even if the amusement park had no right to discharge effluent from a sanitation plant into the stream, the town was not justified in obstructing the culvert. However, a property has no right to materially increase the flow of water from his land so as to cause injury to downstream land owners. (Watson-Fla)
W69-01277

RIGHT TO INUNDATE LAND AS RENDERING TITLE THERTO UNMARKETABLE,
C. S. Patrinelis.
15 ALR 2d 966-967.

Descriptors: *Flooding, Legal aspects, *Market value, Judicial decisions.
Identifiers: Reserved rights, Encumbered title.

The general rule is that title to land is rendered unmarketable where there is a reservation of rights or interest in the land incompatible with full enjoyment and ownership of that land. The vendor is not obligated to accept an encumbered title when there was no express exceptions to such reservations in the contract. There have been no departures from this general rule when the right reserved was to inundate land. (Sisserson-Fla)
W69-01279

FREDERICK V UNION CARBIDE CORP)LIABILITY FOR FLOOD DAMAGE(.
State of West Virginia, Charleston.

168 F Supp 808-811 (D C W Va 1959).

Descriptors: *West Virginia, *Judicial decisions, Water law, *Flood damage, Flood gates, *Negligent inundation, Streams, Culvert, Flooding, Damage, Water law.
Identifiers: Act of God.

Plaintiffs allege that defendant's negligence in maintaining an improper floodgate and wire mesh fence over a stream impeded the flow of debris-carrying flood waters, causing the waters to dam up and rise into plaintiff's store. After defendant removed the flood gate and changed the location of the fence, subsequent floods of similar intensity failed to cause any backing up. The court held the flood not to be an act of God because reasonable human foresight, pains and care could have prevented the result. To relieve from liability, the act of God must be the sole and proximate cause of the injury. Defendant was held to be negligent because he failed to fulfill his duty which was stated as 'the exercise of reasonable care in the maintenance of a culvert (have a floodgate and fence) commensurate with size of the watercourse and with the area and character of the country that it must naturally drain.' (Childs-Fla)
W69-01282

RIVER DEVELOPMENT CORP V LIBERTY CORP)SUBAQUEOUS LAND RECLAMATION(.
State of New Jersey, Trenton.

29 N J 239, 148 A 2d 721-722 (1959).

Descriptors: *New Jersey, Judicial decisions, River beds, *Land reclamation, Legislation, Permits, *Ownership of beds.

Plaintiff held a statutory authorization or license to reclaim subaqueous land of a river and sought to enjoin the defendant from conducting dredging operations in the river. Since the license to reclaim the land had remained unexercised for a period of 86 years, any rights thereunder are held to have expired. Mere non-use is not sufficient to sustain a finding of abandonment. It is unreasonable to assume that the license to reclaim conferred a vested right in perpetuity in the subaqueous lands. By implication of law it must be assumed that the parties intended the receiver of the license to reclaim and acquire actual ownership of the fee within a reasonable time. (Molica-Fla)
W69-01285

JOHNSTON V MILLER)ACCELERATED FLOW OF SURFACE WATER(.
State of Ohio, Columbus.

240 NE 2d 566-569 (Ct App Ohio 1968).

Descriptors: Judicial decisions, *Ohio, Damages, Tile drainage, Surface waters, *Drainage systems, *Erosion, Washouts, Natural flow.

In the lower court the plaintiff won damages and an injunction on the ground that the drainage system installed by the defendants had concentrated, diverted, and accelerated the flow of surface water across the plaintiff's land causing washout and erosion. The court of appeals held that whether or not surface water flowed naturally from the defendant's land or was diverted and concentrated by a tiling system was a jury question, and it would not reverse the decision of the jury. The court of appeals also stated that an upper land owner cannot lawfully increase the burden on lower lands by collecting surface water and discharging it in larger quantities and at points other than those established by natural drainage. (Watson-Fla)
W69-01286

DIMMOCK V CITY OF NEW LONDON)WRONGFUL DIVERSION OF WATER FROM BROOK(.
State of Connecticut, Hartford.

245 A 2d 569-574 (Conn 1968). 6 p.

Descriptors: Judicial decisions, *Connecticut, Damages, Streams, Diversion, *Riparian rights, Streamflow, Ponds, Channels, Water quality, *Natural flow doctrine, Prescriptive rights, Invasion, Reservoirs.
Identifiers: Injunction, Equity.

The city successfully defended this action for injunction and damages in the trial court. On appeal it was reversed in favor of the plaintiff. This court held that a riparian owner is entitled to the natural flow of the water of a stream through or along his land, in its accustomed channel, undiminished in quantity and unimpaired in quality. Regardless of any perceptible, actual damage which a lower riparian plaintiff may be able to prove resulted from a wrongful diversion by an upstream defendant, such a diversion is an invasion of the rights of the plaintiff. If the invasion was continued for a period of 15 years it would confer a prescriptive right upon the defendant to divert the stream. Because the diversion of the water was necessary to supplement the public water supply and the plaintiff's damages were found to be nominal by the trial court, an injunction was granted and the city was allowed a reasonable time to make adequate compensation to the plaintiff. (Watson-Fla)
W69-01287

SEC 137 RAISING WATER SO AS TO INJURE MILL–SEC 138 INJURY TO DAM, RESERVOIR, ETC.
State of Massachusetts, Boston.

Mass Ann Laws Ch 266, Secs 137-138 (1967).

Descriptors: *Massachusetts, Legislation, *Dams, Reservoirs, Canals, Ditches, *Water injury, Floods, Damages, Obstruction to flow, *Mills.
Identifiers: Crimes.

Sec 137 provides that whoever, by maintaining a dam, knowingly causes waters to rise so as to injure a lawfully existing mill, shall be punished by a fine of not more than $1000 or imprisonment for not more than 6 months. This section shall not apply where the courts of the state have jurisdiction to abate the dam. Sec 138 provides that whoever intentionally injures a dam, reservoir, canal, mill, or any appurtenances thereto, or willfully draws off. or obstructs the flow from, any mill pond, reservoir, etc., shall be imprisoned for not more than 5 years or fined not more than $500 and imprisoned for not more than two years. (Williams-Fla)
W69-01290

DIVISION OF WATER RIGHTS AND OTHER INCORPOREAL HEREDITAMENTS; PARTITION OF WATER IN A NATURAL STREAM, ETC.
State of Massachusetts, Boston.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01291

LIABILITY OF LANDOWNER FOR DAMAGES CAUSED BY OVERFLOW, SEE PAGE, OR THE LIKE RESULTING FROM DEFECT IN ARTIFICIAL UNDERGROUND DRAIN, CONDUIT, OR PIPE,
W. R. Habeeb.
44 ALR 2d 960-972.

Descriptors: Damages, Flood damage, *Subsurface drainage, *Subsurface drains, Conduits, Pipes, *Legal aspects, Artificial watercourses, Surface drainage, *Obstruction to flow, Construction.
Identifiers: Defective construction, *Ordinary care.

Jurisdictions were divided on the liability of landowners for damage resulting from defects in artificial underground drains, conduits, or pipes. Decisions ranged from directed verdicts for either plaintiff or defendant. A number of jurisdictions held defendant to a duty of ordinary care, a question of fact, to see that no injury came to adjacent property owners. The general rule seems to be that a defendant landowner, whether upper, dominant, or controlling, or lower or servient, is liable for damage to adjacent property owner's land as a result of defective construction of artificial drains. An exception was when damages arose from extraordinary and unprecedented flows. City property owners may protect their land from surface water flowing from adjacent land, even if it involved obstructing an artificial drain. (Sisserson-Fla)
W69-01292

WHEN STATUTE OF LIMITATION COMMENCES TO RUN AGAINST DAMAGE FROM OVERFLOW OF LAND CAUSED BY ARTIFICIAL CONSTRUCTION OR OBSTRUCTION,
E. H. Schopler.
5 ALR 2d 302-386.

Descriptors: *Judicial decisions, Obstruction to flow, Waterway, *Overflow, Flood damage, Drainage systems, *Legislation, *Natural flow, Eminent domain, Louisiana, Massachusetts, Embankments, Public utility, Cities, Railroads.
Identifiers: Statute of limitations.

Two questions are presented concerning damage caused to land by artificial construction or obstruction which results in overflow: (1) when does the statute of limitations start to run; and (2) for what part of the cause of action does it run. Permanent and continuing injuries are distinguished as to their effect in starting the limitation period. The permancy, lawfulness, negligence in construction, and removability of the obstruction are all factors in classifying the injury for purposes of determining the beginning of the limitation period. Four characteristic groups of cases are distinguished. The first two groups are concerned with whether the limitation period begins when the obstruction is completed or when, after such completion, injury caused by overflow becomes manifest. The last two groups of cases deal with circumstances by which successive injuries begin the limitation period for the entire cause of action or only for separate causes as and when they accrue. There is disagreement as to when the limitation period begins for acts by municipalities, improvement districts, private individuals or corporations or railroads. (Childs-Fla)
W69-01298

CANAL COMPANIES.
State of Georgia, Atlanta.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01302

AN ACT TO AMEND...AN ACT CONCERNING THE ESTABLISHMENT, DEVELOPMENT AND OPERATION OF PUBLIC PORTS, CREATING THE INDIANA PORT COMMISSION AND DEFINING ITS POWERS AND DUTIES.
State of Indiana, Indianapolis.

Indiana Laws Ch 210 (1967).

Descriptors: *Indiana, Legislation, *Port authorities, Harbors, Navigation, *Canal construction, Repairing, Condemnation, Cost repayment, Project planning, Administrative agencies, Public benefits.

This Act is an addition to chapter 11 of the Acts of the Indiana General Assembly for the year 1961. It adds to and defines new powers of the Indiana Port Commission. The commission is authorized to construct new canals, and repair and improve existing canals and waterways for the purpose of connecting ports under the commission's jurisdiction with other such waterways. The commission is not authorized to condemn any existing property right and is required to reimburse any public or private facilities for damage resulting from construction or repair of canals. (Sisserson-Fla)
W69-01303

AN ACT...TO CHANGE THE DEFINITION OF WATERS..., TO CHANGE THE DEFINITION OF POLLUTION, TO EXEMPT TIDAL WATERS..., CERTAIN DRAINAGE SYSTEMS FROM THE PERMIT REQUIREMENTS.
State of Maryland, Annapolis.

Maryland Laws ch 416 (1967).

Descriptors: *Maryland, Legislation, Administrative agencies, *Permits, Reservoirs, Dams, Obstruction to flow, Construction, Repairing, *Water pollution, Tidal waters, Drainage systems, Administration.
Identifiers: *Public hearings.

This Act repealed and re-enacted, with amendments, sections 2 (E), (G), 12 (A) and 15 of Article 96A of the Annotated Code of Maryland (1966 Supplement), title 'Water Resources', subtitles 'General Provisions' and 'Appropriation of Waters, Reservoirs and Dams.' 'Waters of the State' and pollution are defined. It is unlawful for anyone to construct or repair a reservoir, dam or water obstruction without a permit from the Department of Water Resources. Excepted from this requirement are: dams and obstructions under ten feet in height; reservoirs with a storage capacity of less than one million gallons; reservoirs constructed under a permit of the State Department of Health; structures impounding waters less than four feet in depth for the propagation of wildlife species; and drainage systems designed for collection, conveyance and

disposal of storm water. Public hearings are mandatory for permit applications to alter, in any manner, the course of any waters of the state. (Sisserson-Fla)
W69-01306

DUNLAP V HARTMAN)TITLE TO ACCRETION(.

338 S W 2d 10-13 (Mo 1960).

Descriptors: *Missouri, *Missouri River, *Accretion (Legal aspects), *Boundaries (Property), Remedies, Adjudication procedure, Judicial decisions.
Identifiers: Quiet title, Adverse possession.

Owners of land adjoining the Missouri River sought to quiet title to land formed by accretion between what had been an island owned by defendants and the mainland. The Circuit Court quieted title in plaintiffs and defendants appealed. This court held that whether the land had accreted to the mainland or the island was a question of fact, and affirmed the judgment. Similarly, whether or not defendants had acquired title by adverse possession was a question of fact. (Kahle-Fla)
W69-01315

BACORN V STATE)OWNERSHIP OF NAVIGABLE RIVER BED(.

20 Misc 2d 369, 195 N Y S 2d 214-220 (1959).

Descriptors: Judicial decisions, *New York, *Ownership of beds, *Navigable rivers, Flood control, State jurisdiction.

Claimants brought suit against the state to recover money judgments for lands which they claimed were owned by them and were taken by the state without compensation. The state published notice of its taking of perpetual easements in two parcels of land on the Chemung River, for the purpose of the 'Elmira Flood Protection Project.' The state contended that the river was navigable and that its activities were restricted to the river bed. The claimants contended that the river had not been used for navigation for years and that even if it was a navigable river, the state's action had no relation to navigation. The Court of Claims found that the river was navigable and that the state had merely exercised public powers over public waters for which private interests must yield without compensation. The state's power is not restricted to regulation of navigation. Claimants failed to establish that the parcels were not in the river bed and the fact that such parcels were not subject to a continuous flow of water did not establish that they belonged to claimants through accretion. (R.F. Williams-Fla)
W69-01316

OWNERSHIP AND CONTROL OF WATER BOTTOMS AND CONTROL OF THE SHELLFISH INDUSTRY.
La RS 56: 421, 424, 425, 495 (1965).

Descriptors: *Louisiana, Legislation, *Administrative agencies, *Commercial fishing, Shellfish, *Ownership of beds, Rivers, Lakes, Bays, Gulf of Mexico, State governments, Judicial decisions, Leases, Coasts.
Identifiers: Bi-valve industries.

The bottoms of bodies of water bordering on or connected with the Gulf of Mexico and all shellfish grown thereon are the property of the state. No conveyance of these bottoms can be made by any political official. The leasing of waters for mineral purposes is not affected. Water bottoms and natural reefs in waters of this state may be leased. No claim to any water bottoms suitable for oyster culture is valid until adjudicated as to the question of title. No lease of bedding grounds lawfully made before July 27, 1932, is affected by this act. Owners of expiring leases have first right of renewal. The methods for granting leases to water bottoms and the regulations applicable after such lease has been made are provided by this act. The waters of Louisiana for purposes of the act are classified as either inside or outside waters. The pertinent factors for this classification are stated. This act is annotated. (Childs-Fla)
W69-01320

UNITED STATES V MCFADDEN)ACTION TO QUIET TITLE(.

171 F Supp 628-631 (D C Ky 1959).

Descriptors: *Kentucky, United States, Judicial decisions, Real property, *Land tenure.

The United States brought an action to quiet title to a tract of land. Defendants, by counterclaim, sought to have title to a five acre portion of the tract quieted in them. At issue was the line between the government land and defendant's land. The deed to the government land called for the boundaries to follow the meanders of a stream. The defendant's deed called for a boundary in courses and distances. There was conflict between these two boundaries. Under Kentucky law, where a deed calls for the meanders of a stream as a boundary they must be followed and the courses and distances yield to the winding path of the stream where there is conflict. Thus, the United States was entitled to a judgment quieting title in it. (Childs-Fla)
W69-01324

COUNTY BOARD OF SUPERVISORS FOR MECOSTA COUNTY V DEPARTMENT OF CONSERVATION)TO ENJOIN LOWERING OF RESERVOIR LEVEL(.
160 N W 2d 909-927 (Mich 1968) 19 p.

Descriptors: Judicial decisions, *Michigan, Reservoirs, Administrative agencies, Lakes, Streams, *Water levels, Wildlife habitats, Riparian land, Riparian rights, Flow, Easements, Flooding, Legislation, Conservation, *Dams, Fishing, Navigable waters, Impoundments.

The Supreme Court of Michigan ruled that an attempt by riparian owners to enjoin court determination of the height of an artificial lake was properly dismissed. The legislature did not intend to preclude the county supervisors from proceeding to have established the normal level of the lake which resulted from the construction and maintenance of a dam. The conservation department had acquired approximately two-thirds of all the riparian land involved and the remaining riparian owners had granted flowage easements to the state and had authorized the use of the water of the flooded area for public purpose. Therefore the action by the riparian owners to enjoin the conservation department from lowering the normal level by some 18 in. was properly dismissed. (R. H. Watson-Fla)
W69-01327

MODERN STATUS OF RULES GOVERNING INTERFERENCE WITH DRAINAGE OF SURFACE WATERS,
W. E. Shipley.
59 ALR 2d 421-445.

Descriptors: *Surface drainage, *Drainage water, *Legal aspects, Land tenure, *Reasonable use, Relative rights, Obstruction to flow, Natural flow doctrine, Competing uses, Repulsion (Legal aspects), Civil law.

There were originally two basic rules applied by the courts in cases involving drainage of surface waters. The common enemy doctrine allowed the landowner to do anything he pleased on his own land in dealing with the disposal of surface water drainage, without liability to adjoining landowners. The civil law rule, on the contrary, allowed no interference with the natural course of water drainage by landowners, and also prohibited artificial removal or increase of the water drainage. Both of these extreme views have been modified over the years. The tort principles of reasonable use and negligence have been applied by several states. Some courts have abandoned both rules and have adopted a third rule, the reasonable use doctrine, where the rights of the parties are determined by assessing all the relevant factors. These doctrines are most frequently called into use when the lower landowner dams back water, a landowner augments natural drainage, or when there are conflicts over the collection and discharge of water. (Sisserson-Fla)
W69-01329

RIGHT OF RIPARIAN OWNER TO CONSTRUCT DIKES, EMBANKMENTS, OR OTHER STRUCTURES NECESSARY TO MAINTAIN OR RESTORE BANK OF STREAM OR TO PREVENT FLOOD.
23 ALR 2d 750-761.

Descriptors: *Embankments, *Riparian land, *Riparian rights, Floods, Flooding, Flood damage, Dikes, Levees, Natural streams, Watercourses (Legal), Banks, Water law, Legal aspects, Judicial decisions.

The annotation discusses the right of a riparian owner on a natural watercourse to construct embankments along his bank of the stream to protect his land. The general rule is that he does not have that right if the embankment constructed will cause ordinary flood waters to damage the lands of others. Some jurisdictions allow the construction of protective embankments and some jurisdictions hold that flood waters are surface waters and a common enemy against which a riparian owner may fight. The general rule only applies to damage to the land of others which is caused by ordinary flooding. If the embankment would not cause damage to another's land in times of ordinary flooding but would only in case of an extraordinary flood the embankment would be allowed. (Horner-Fla)
W69-01330

105-1407 WATERCOURSES: DIVERSION, OBSTRUCTION, OR POLLUTION AS CONSTITUTING TRESPASS 105-1408 UNDERGROUND STREAMS, INTERFERENCE WITH.
105 Ga Code Ann secs 105-1407, 105-1408 (1967).

Descriptors: *Georgia, Legislation, *Riparian rights, Alteration of flow, Diversion, Obstruction to flow, Reasonable use, *Natural flow doctrine, Streams, *Underground streams, Water law, Legal aspects, Non-navigable waters, Overlying proprietor.

Sec 105-1407 provides that a riparian owner on a non-navigable watercourse is entitled to have its water come to his land in its natural and usual flow, subject only to reasonable use by other riparian owners. Diversion, obstruction or pollution of the stream, impeding its flow, causing it to overflow, or diminishing its value and thus causing injury to riparian land or a right appurtenant thereto, shall be a trespass to such riparian land. Sec 105-1408 provides that since the course of an underground stream and its condition before its first use are so difficult to ascertain, trespass may not be brought for alleged interference with the rights of an overlying proprietor. (R. F. Williams-Fla)
W69-01334

STANDARDS OIL CO)INDIANA(V JOINT BOARD OF SUPERVISORS OF HARRISON AND MONONA CTYS)EXPENSES OF

RELOCATING PIPES NECESSITATED BY CHANGE IN DRAINAGE CHANNEL(.
State of Iowa, Des Moines.

94 N W 2d 312-321 (Iowa 1959) 10 p.

Descriptors: Judicial decisions, *Iowa, Channels, Administrative agencies, Drainage, *Ditches, *Pipelines, Drainage districts, Rivers, Permits.

Standard Oil sued the board to recover expenses incurred in relocating a pipeline necessitated by a change in a drainage channel by the district. An award was made in the lower court, but the supreme court reversed because the pipeline company, in application to the board of trustees of the drainage district for a permit to construct pipe line across the drainage ditch, had voluntarily offered to bear any expenses of relocating its pipeline necessitated by a change in the location of the drainage ditch. The pipeline company could not avoid its obligation to pay the expenses on the ground that the trustees were without power to accept the conditions. (Watson-Fla)
W69-01339

BELL V UNION ELECTRIC CO)FLOOD DAMAGE CAUSED BY DAM(.
367 S W 2d 812-822 (K C Ct App Mo 1963).

Descriptors: *Flooding, *Flood damage, Flood gates, *Floods flow, Riparian land, Dams, Real property, Water levels.
Identifiers: Flow retardation, Trespass.

The plaintiff claimed that a dam owned and operated by the defendant caused the flooding of his property and damage to his crops. The trial court found that where the flows of a river were retarded because of silt caused by a dam, and the presence of a lake held by the dam retarded the flow of the river and the operation of the floodgates of the dam and these factors combined to cause the flood waters going upon the plaintiffs' land, the dam owner is liable for damages caused by the flood. The court of appeals affirmed noting that the action was in the nature of a trespass and not negligence. (Horner-Fla)
W69-01349

TRUSTEES OF THE INTERNAL IMPROVEMENT FUND V VENETIAN ISLES DEV CORP)PERMIT TO DREDGE AND FILL(.

166 So 2d 765-768 (1 Dist Ct App Fla 1964).

Descriptors: *Florida, *Beds, *Administrative agencies, *Permits, Dredging, Bulkheads, Legal aspects.

The plaintiff corporation was issued a permit to dredge and fill certain bottomlands by the Pinellas County Water and Navigation Authority. The permit had been approved by the Trustees of the Internal Improvement Fund. Latter, the corporation filed an application with the Authority for an extension of the permit completion time. The Authority voted to extend the completion time. The Trustees never approved the extension and the plaintiff instituted action to determine the rights of the parties. The court held that the Authority properly exercised its powers in extending the permit, and, after doing so, its right to act ceased. The Trustees did not have the power to exercise independent judgment in this case and they were ordered to approve the extension. (Horner-Fla)
W69-01352

VOLKERDING V BROOKS)ACCRETION AND ADVERSE POSSESSION IN MISSOURI(.
359 S W 2d 736-743 (1962).

Descriptors: *Missouri, *Accretion (Legal aspects), *Boundaries (Property), Riparian rights, Riparian land, Water law, Judicial decisions.
Identifiers: Adverse possession.

In an action to quiet title, the trail court held for the plaintiff as against the defendant's answers of title by adverse possession and by reason of accretion. However, on appeal, the court in the instant case reversed as to the issue of title by reason of accretion. The court stated that the law governing the matter held a riparian owner to own to the low water mark on navigable streams. Riparian ownership is essential to ownership of accretions, ie, accretions depend upon actual contiguity, without any separation of the claimant's land from the accumulated alluvion by the lands of another. A corollary of this rule is that if the shore lines of two bodies of land, such as islands, are divided by a watercourse, then receive accretions until the shorelines come together, the line of contact will be the division line. The court remanded the case because the evidence presented by the plaintiff was not sufficient to establish that his property extended to the water's edge. (Patterson-Fla)
W69-01363

BLACK V CLARY)ACCRETION AND ADVERSE POSSESSION IN ARKANSAS(.

364 S W 2d 528-530 (1963).

Descriptors: *Arkansas, *Accretion (Legal aspects), Legal aspects, *Boundaries (Property), Riparian land, Judicial decisions.
Identifiers: *Adverse possession.

In affirming a ruling of the trial court judge enjoining the defendant from trespassing on the plaintiff's accreted lands, quieting title in the plaintiff and awarding damages, the court in the instant case stated that the result was justified on the basis of acquisition by accretion and by adverse possession. Upon reviewing the record as a whole, the court found that the plaintiff's possession had been both adverse and continuous for a period of seven years. It was also stated that notice of adverse possessions may be actual or inferred from facts and circumstances. (Patterson-Fla)
W69-01364

PEOPLE V SPENCER)TITLE TO ACCRETED LAND(.

5 Mich App 1, 145 N W 2d 812-816, (Ct App Div 3 Mich 1966).

Descriptors: *Accretion (Legal aspects), *Boundaries (Property), Judicial decisions, Water law, Legal aspects, *Michigan.

This was an action to determine title to certain lands built up by accretion. During the time that the accretion was taking place on the two adjoining lakefront lots, both were owned by the same person. Subsequent to the accretion, part of the two lots was dedicated to the state as a public park, and the remainder was sold to the defendant. In Michigan, where the boundary of a piece of property is a shoreline, the shoreline is the boundary notwithstanding its subsequent recession or advancement. Where title to two lots was in a common owner, and the lots were added to by accretion, the common grantor may convey the new land without adherence to the new boundary established by accretion. The court held here that the grantor's intent controlled, and that the grantor intended to convey the accreted land to the defendant, hence relief was denied. (Batchelor-Fla)
W69-01372

BOROUGH OF WILDWOOD CREST V MASCIARELLA)TITLE TO ACCRETED LAND(.
222 A 2d 138-145 (Super Ct N J 1966). 92 N J Super 53.

Descriptors: *Accretion (Legal aspects), Bank erosion, Boundaries (Property), Water law, Legal aspects, Judicial decisions, *New Jersey.

This case deals with the question of whether the State or upland owners are entitled to gradual and imperceptible accretion. The court discusses the proposition that the owner of lands along the sea is obliged to accept the alterations of his boundaries. A distinction is then drawn between accretion by natural forces, and that which is artificially caused. While recognizing that natural accretion inures to the benefit of upland owners the court treats this as a case of first impression as to artificial accretion. After a discussion of authorities in other jurisdictions the court concludes that the better rule is that the alluvion formed by gradual and imperceptible accretion, whether caused in whole or in part by artificial means, inures to the benefit of the upland owner. Finally the court places two limitations on this rule. The first restriction applies when the artificial accretions are caused solely by the act of the upland owner. The record involves projects by a governmental agency in the aid of navigation. (Batchelor-Fla)
W69-01373

JONES V WILLIAMSON)DRAINAGE EASEMENT(.
220 N E 2d 645-648 (3d Dist Ct App 111 1966). 74 111 App 2d 367.

Descriptors: *Easements, Legal aspects, Water law, Ditches, Diversion structures, Surface drainage, *Surface runoff, Drainage water, *Illinois.

This case deals with the construction of a drainage ditch to dispose of surface water runoff. The upland owner and the adjoining lower land owner agreed orally to the construction of this ditch. The lower land was then sold to Jones, who had no knowledge of the agreement. Jones now seeks to enjoin the upland owner from discharging surface water from the diversion ditch onto the lower property. It is acknowledged that an upland owner does not have a right to discharge water from a ditch onto lower land merely because he is the owner of upper land. The court then goes into the application of an 111 statute pertaining to construction of drainage ditches by mutual consent of the owners. The case holds that where a drainage ditch, constructed by mutual agreement, forms a continuous line across adjoining lands a perpetual easement exists on such lands. It is further held that where there are open visible marks of a drainage ditch easement the purchaser has a duty of inquiry and is bound by such easement. (Batchelor-Fla)
W69-01374

FREESTATE INDUSTRIAL DEVELOPMENT CO V T AND H INC)OBSTRUCTION TO NATURAL FLOW OF SURFACE WATERS(.
188 So 2d 746 (La Ct App 1966).

Descriptors: *Remedies, *Louisiana, *Surface drainage, Construction, *Alteration of flow, Relative rights, Adjudication procedure, Natural flow doctrine, Legislation.

Plaintiff sought injunctive relief to prohibit defendant from altering the natural flow of surface drainage so as to cause drainage from defendant's property to flow upon plaintiff's property. In the alternative plaintiff prayed for compensatory damage. Prior to April, 1964 there was a ridge on defendant's property near the common boundary line of plaintiff's property which caused the major portion of surface drainage to flow away from plaintiff's land. Subsequently defendant made improvements on his property which plaintiff alleges caused surface water to flow onto his property. The lower court dismissed plaintiff's alternative demand for damages because the prescriptive period of one year had lapsed. This court reversed and remanded holding that plaintiff sought damages only in the event that injunction was denied. It is an established principle in Louisiana that compensatory damages may be awarded in lieu of injunctive relief. Such damages are not subject to the prescriptive period found in Articles 3536 and 3537 of the Louisiana Revised Civil Code. (Kahle-Fla)

W69-01376

CLEMONES V ALABAMA POWER CO)FLOODING CAUSED BY DAM CONSTRUCTION(.
250 F Supp 433-439 (N D Ga 1966).

Descriptors: *Georgia, Legal aspects, Judicial decisions, *Flood damage, Backwater, Dams, Reservoirs, Rain, Excessive precipitation, Floods, Public utilities.
Identifiers: Act of God.

This is an action for damages against an electric utility for the flooding of plaintiff's property behind the utility's recently constructed reservoir after heavy rains. The facts showed that the defendant had made a detailed study of flooding in the area prior to the construction of the facility and this gave them a reasonable warning of the likely recurrence of flooding. Consequently, under Georgia law the heavy rains which transpired were not so extraordinary as to free the defendant of all liability. The acts and omissions of the defendant constitute a trespass by human agency even though coupled with acts of God. As a trespasser the defendant is liable for harm caused by it, and this liability is the apportioned amount of damage to the plaintiff not caused by the act of God. (P. N. Smith-Fla)
W69-01382

IN RE BUREAU OF WATER SUPPLY)RESERVOIRS AND NATURAL FLOW(.

219 A 2d 409-413 (N J 1966).

Descriptors: Rivers, Navigable waters, Salinity, Utilities, *Water utilization, *Water quality, Wastes, Flow control, Reservoirs, Contracts.
Identifiers: Minimum flow rate.

In 1918, New Jersey approved the application of the water company to divert water from state rivers, subject to the condition that if it became necessary to provide storage of storm waters to supply consumers the expense would be apportioned among the consumers using water from the rivers. Subsequently, reservoirs were built to hold storm waters in order to provide minimum flow rates in the rivers and to supply consumer needs. The petitioner, water company, contended that the 1918 grant was a franchise which gave it a vested interest in the water and that it should not have to pay a portion of the cost of the reservoirs and that if it did have to pay, the amount should be reduced by the portion of the project that went toward maintaining minimum flow rates. The court held that the petitioner had agreed to pay a proportion of the cost of the reservoirs and that the maintenance of minimum flow rates benefited the water consumers by keeping the rivers clean and reduced salinity. (Horner-Fla)
W69-01387

ROBINSON V HUMBLE OIL AND REFINING CO)EFFECT IN CHANGE IN LOCATION OF STREAMBED ON BOUNDARY(.

176 So 2d 307-319 (Miss 1965).

Descriptors: *Accretion (Legal aspects), *Avulsion, Boundaries (Property), Real property, Meanders, Channels, Alluvial channels, Erosion, Riparian rights, Riparian land, Water law, Legal aspects.
Identifiers: Evidence, Proof of facts.

The litigation concerned the title to a parcel of land situated between the old and the present bed of a stream. The stream was the original boundary between the land of the complaintant and that of the defendant. The complaintant alleged that the change in the stream was by avulsion and therefore the boundary did not change from the old stream bed. The court held that the evidence supported the chancellor's conclusion that the change was caused by accretion and that the boundary changed with the stream. The owners of land bounded by a stream own to the thread of the current of the stream; but the boundary shifts with gradual non-avulsive changes in the stream. In the absence of countervailing evidence, the presumption of gradual erosion and accretion prevails when the lay of the land, the length of elapsed time as related to the distances of the movement and the general correspondence of the location and directions of the river at the later period as compared with that of the earlier, are such that the stated presumption may be reasonably entertained. (Horner-Fla)
W69-01391

PADGETT V CENTRAL AND S FLA FLOOD CON DIST)EFFECT OF LOWERING WATER LEVEL ON RIPARIAN TITLE(.

178 So 2d 900-905 (2 DCA Fla 1965).

Descriptors: *Florida, *Accretion (Legal aspects), Riparian rights, Riparian land, Boundaries (Property), Real property, High-water mark, Banks, Lakes, Water levels, Levees.

The controversy involves the rights of the defendant landowner whose property was situated on the bank of Lake Okeechobee until the state lowered the level of the lake thereby leaving a strip of land between the property and the lake. The state constructed a levee on that strip of land thereby depriving the plaintiff of access to and a view of the lake. The land presently belonging to the defendant was reclaimed land which had originally belonged to the state. The court held that the statute authorizing the conveyance to the defendant gave the state the right to change the status of the defendants lands so that they would no longer be lands with riparian rights. Where the state causes the level of a navigable lake to be lowered and thereby uncover lands below the original high water mark, lands so uncovered continue to belong to the state and do not vest in the riparian owner through the doctrine of accretion. (Horner-Fla)
W69-01393

DRAINAGE PROBLEMS IN AN AREA CHANGING FROM RURAL TO URBAN,
Robert W. Brannan.
Pub Works, Vol 93, p 10, 1962.

Descriptors: *Land use, Drainage systems.
Identifiers: *Urban drainage.

Gives some discussion on economic losses due to urbanization and poor drainage for Lucas County, Ohio. Also regulatory control methods that should be considered.
W69-01523

NATURE AND SCOPE OF SURFACE DRAINAGE IN EASTERN UNITED STATES AND CANADA,
E. W. Gain.
Am Soc Agric Engrs-Trans, Vol 7, No 2, pp 167-9, 1964.

Descriptors: *Surface drainage, *Design.
Identifiers: Interceptor sewers, United States, Canada.

Review of basic surface-drainage systems now in use includes 'random', 'bedding', 'regular' or 'parallel ditch', 'interception', and 'diversion' systems.
W69-01524

NEW YORK STATE MUNICIPAL WATER AND SEWAGE,
R. D. Hennigan.
Water Sewage Works, Vol 110, No 12, pp 448-52, Dec 1963.

Descriptors: *Planning, Construction, *Legislation, Grants.
Identifiers: *Storm sewers, Urban drainage, New York.

The need for a unified approach to the planning, construction, and operation of all water utility services is stressed. In particular, water service, sewer service, and storm drainage projects should be planned on an integrated basis. New York State laws and constitutional changes have been designed to encourage an integrated approach to the planning of water and sewage works. Recent legislation relating to such planning is described. One provision would enable municipalities to obtain 100% support for approved comprehensive sewer and water studies. The author observes that 'counties are increasingly becoming the focus for providing area-wide water and sewer facilities.' A brief listing of sources of fiscal aid is included.
W69-01525

ATTENUATION OF FLOOD WAVES IN PART FULL PIPES,
P. Ackers, and A. J. M. Harrison.
Proc Instn Civ Engrs, Vol 28, pap No 6777, pp 361-381, 1964.

Descriptors: Pipes, *Hydrographs, *Floods, *Conduits.
Identifiers: Storm sewers.

In the derivation of improved methods for designing storm-water drainage systems it is important to know the way in which the flood hydrograph (or flood wave) is modified as it passes along a conduit under conditions of free surface flow; and an extensive study was therefore carried out using an experimental pipeline installation in which the slope, height, and length of peak of the input hydrograph could be varied. For each set of conditions, depth-time data were automatically recorded and analysed in terms of dimensionless parameters showing that the rate of lowering of the wave peak with time and with distance is a function of the pipe diameter, the Froude number, the depth of base flow, and the volume of fluid in the wave. The volume of the wave, not its shape, is the principal factor affecting the attenuation. The velocity of the peak of the wave was found to be in good agreement with the Kleitz-Seddon law. The peak depth of the wave is a function of the peak discharge which is related to the steepness of the wave, but in most practical cases differs little from the normal discharge. As dimensionless parameters were used the results are applicable to storm sewers of all diameters and floods of all durations and magnitudes, provided the hydrograph is not steeper than those studied.
W69-01552

APPLICATION OF STORAGE ROUTING METHODS TO URBAN HYDROLOGY,
A. P. Aitken.
Instn Engrs, Australia J, Vol 40, No 1-2, pp 5-11, Jan-Feb 1968.

Descriptors: *Storm runoff, Design, Design storms.
Identifiers: *Urban drainage.

Methods of runoff routing developed in Great Britain and in United States are examined and extended in application, so that results may be applied as correction to 'rational method' of design. rational method is specifically derived for localities like Victoria and Great Britain, where runoff from pervious area for design storm is of no significance but it could be applied in other areas with suitable modifications.
W69-01553

DRAINAGE AND BEST USE OF URBAN LAND
Louis H. Antoine, Jr.
Pub Works, Vol 95, p 2, Feb 1964.

Descriptors: *Land use.
Identifiers: *Urban drainage, *Surface permeability, St. Louis (Mo.).

This article discusses a study of drainage channels for the St. Louis area and gives data on the percent of imperviousness for different urban land uses.
W69-01559

DETERMINATION OF RUNOFF FOR URBAN STORM WATER DRAINAGE SYSTEM DESIGN,
K. W. Bauer.
Southeastern Wis Rge Plng Comm Tech Rec, Vol 2, No 4, April 1965. 19 pp.

Descriptors: *Storm runoff, *Design, *Planning, *Drainage systems, *Rainfall intensity, Runoff.
Identifiers: *Urban drainage, *Storm sewers.

Storm water runoff determinations are made to determine design criteria for the planning and design of urban drainage systems. The storm water runoff determination criteria is the rational method whose variables are: the coefficient of runoff, rainfall intensity for the area, time of concentration, and soil information. The application of these criteria should promote common storm sewer design methods and the adoption of common design methods for storm water drainage system design.
W69-01560

RAINFALL AT NEW ORLEANS AND ITS REMOVAL,
G. G. Earl.
Civ Eng, Vol 2, No 5, pp 289-94, May 1932.

Descriptors: *Drainage, *Pumping, *Discharge (Water), Storms, *Rainfall intensity, Rain gages.
Identifiers: *Capacity, New Orleans (La.).

Drainage and sanitation problems; pumping capacity required to discharge accumulation of water in reasonable time; records of storm; drainage pumping stations; effects of irregular rainfall; new type rainfall recorder; extending rainfall data; sanitary systems.
W69-01568

4B. Groundwater Management

ECONOMIC CONTROL OF GROUNDWATER RESERVES,
Missouri Univ., Columbia.
Oscar R. Burt.
J Farm Econ, Vol 48, No 3 Part 1, pp 632-647, Aug 1966. 1 fig, 14 ref.

Descriptors: *Dynamic programming, Aquifers, Distribution patterns, Synthetic hydrology, Water balance, Water allocation (Policy), Public benefits, Economic efficiency, Markov processes, Groundwater recharge, Groundwater mining, Pumping, Marginal return.
Identifiers: Present value.

Sequential decision theory was used to develop a framework for derivation of optimal groundwater policies focused on temporal allocation. The functional equation was derived from a dynamic programming formulation of the problem. The primary criterion of choice was expected present value of net output from the basin, and dispersion of net output is introduced as a secondary consideration. The expected-present-value function and its associated rate-of-use function under an optimal policy were discussed, assuming that some form of 'the 'use' tax method' could be applied to assure that the value-marginal-product function of the producers equalled the marginal-social-benefit function. The decision variables, the rates of use from stock, were functions of the storage level, time, and the rate of recharge, a random variable. Only discrete values of rates of use and storage were permitted. A Markov process analysis of groundwater stocks was presented. (Gysi-Cornell)
W69-01207

OPTIMAL RESOURCE USE OVER TIME WITH AN APPLICATION TO GROUND WATER,
California Univ., Davis, California.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01216

TEMPORAL ALLOCATION OF GROUNDWATER,
Missouri Univ., Columbia.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01220

STORAGE OF FRESH WATER IN UNDERGROUND RESERVOIRS CONTAINING SALINE WATER: PHASE I,
Kansas University, Lawrence.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-01229

SPERRY RAND CORP V WATER RESOURCES COMM'N)REMEDY FOR DAMAGE TO GROUNDWATER SUPPLY(.

291 N Y S 2d 716-718 (Sup Ct 1968).

Descriptors: *New York, *Administrative decisions, *Well permits, Water law, Judicial decisions, Legislation, Water supply.
Identifiers: *N Y Water Resources Commission, Public interest.

The petitioner Sperry Rand Corporation seeks in this action an annulment of a determination of the New York Water Resources Commission permitting a landowner adjacent to the petitioner to utilize well water in a certain way. In granting the application of the adjacent landowner to sink the well in question, the Commission found that the petitioner might thereby be damaged; and the question in this case is whether the Commission must either refuse an application or impose protective conditions when a proposed use will have an adverse effect upon an adjoining owner. The court held that although such an adverse effect should be a factor for the Commission's consideration, its concern by statute was primarily with the public interest and not with the competing interests of two adjacent landowners. Redress for grievances between such landowners should be found in litigation interse se. (Patterson-Fla)
W69-01346

ADAMS V GRIGSBY)INTERFERENCE WITH GROUNDWATER SUPPLY(.

152 So 2d 619-624 (La 1963).

Descriptors: *Groundwater, Wells, *Louisiana, Judicial decisions, Legislation, Percolating waters, Damage, Relative rights, Pumping, Groundwater mining, *Overlying proprietor, Water sources, Water supply, *Water wells, Draw down.
Identifiers: Injunction, English rule, Damages (Legal aspects), American rule, *Fugitive substances.

This was an action by residential property owners, who obtained water from a common underground source, for an injunction and damages against defendant for alleged wrongful depletion of the water supply by excessive pumping. Defendant sunk wells and pumped large quantities of subterranean fresh water for use in his oil recovery operations. The court denied plaintiffs' claims. The court rejected plaintiff's contention that underground waters were covered by articles of the Louisiana Civil Code dealing with drainage and the use of running water. The court held that groundwater, like oil and gas, is a fugitive substance, and hence belongs to whoever captures and makes use of it. Hence plaintiffs have no cause of action where defendant, by pumping groundwater from wells on his own land, reduces plaintiffs' supply from the common underground source. The court rejected both the English Rule, (owner owns and may use ground water, but not so as to injure his neighbor) and the American Rule (correlative rights). The court indicated that had defendant wasted the water, relief would have been granted. (Kirkconnell-Fla)
W69-01350

THE EFFECT OF PUMPING OVER AN AREA,
Colorado State Univ, Fort Collins.
Robert E. Glover.
Symp Amer Water Resour Ass, San Francisco, Calif, pp 149-156, Nov 1967. 8 p, 1 fig, 4 ref.

Descriptors: *Drawdown, *Water table, *Ground water, Aquifers, Theory, Areas, Pumps, Wells, Observation wells, Estimating, Forecasting, Charts, Geometric shapes.
Identifiers: *Pumping, Groundwater depth, Formulas, Pumping tests, Groundwater movement.

Lowering of the water table caused by pump operation can be estimated in terms of drawdown at a corner of a rectangle over which the pumping is uniformly distributed. A chart gives the drawdown at a corner in terms of the width to length ratio and a dimensionless parameter involving the length, aquifer constant, and time. Drawdown at selected points either inside or outside the area of interest can be estimated by adding, or adding and subtracting, the drawdown produced by pumping over suitably chosen rectangles. A pumped area of irregular shape can be represented approximately by the sum of rectangles. To determine total drawdown at a selected well, the drawdown produced by the well discussed in this paper must be added to the drawdown produced by distributed pumping. (USBR)
W69-01415

FIELD OBSERVATIONS COMPARED WITH DUPUIT-FORCHHEIMER THEORY FOR MOUND HEIGHTS UNDER A RECHARGE BASIN,
Agricultural Research Service, Fresno, California.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-01492

4C. Effects on Water OF Man's Non-Water Activities

BAYSHORE V STECKLOFF)RIGHT TO FILL BAY FRONT LOTS(.
State of Florida, Tallahassee.

107 So 2d 171-175 (3d D C A Fla 1958).

Descriptors: *Florida, Judicial decisions, Legislation, Riparian rights, Ownership of beds, *Landfills, *Bulkheads, *Coastlines, Beds, Shores, Bays.

Plaintiffs and defendants have adjoining bay front lots. Plaintiffs' lots were filled in and bulkheaded. Subsequently, defendants sought to fill in and bulkhead their lots as permitted under Fla Stat sec 271.01 (1955). Plaintiffs sought a declaratory decree to prevent defendants' action, which would close off the south waterfront side of their lots, on the basis of ch 57-362, Laws of Fla, which repealed the 1955 statute and on the grounds that they have acquired riparian rights on the lateral sides of their lots. The question of whether plaintiffs have acquired riparian rights on the lateral sides of the filled land does not need to be answered because the defendants are also entitled to fill in their lots pursuant to the 1955 statute. By provision the defendants are exempted from the effect of the 1957 statute. (Molica-Fla)
W69-01281

U S V HARRISON COUNTY, MISSISSIPPI)SUIT BY U S TO END DISCRIMINATION AT PUBLIC BEACH BUILT WITH FEDERAL GRANT(.
399 F 2d 485-492 (5th Cir 1968). 8 p.

Descriptors: Judicial decisions, *Mississippi, Beaches, Sands, *Recreational facilities, Sea walls, Grants, *Federal government, Financing, Accretion (Legal aspects), Littoral, Riparian land.
Identifiers: Injunction, Artificial accretion.

The court of appeals reversed the trial court and held that a sand beach and sea walls built with aid of federal funds must be available to all of the general public because it was so stipulated in the contract. The decision of the Mississippi Supreme Court that artificially made sand beaches belonged to the owner of the adjacent property by artificial accretion was held not to be res judicata as to the rights of the U S in this case. The circuit court of appeals in this case held that the Miss Constitutional provision that lands belonging to the state shall never be donated to private persons superseded and abrogated the common law doctrine of artificial accretion. In dicta the court stated that the use of publicly owned beaches is subject to reasonable regulations by the state in exercise of its police powers and such public use must be enjoined in compliance with all valid laws of the state. Also that public use of beaches cannot unreasonably interfere with the littoral rights of the adjoining landowners. (Watson-Fla)
W69-01288

TAKING OF LAND, ETC., FOR PUBLIC ACCESS FACILITIES, ETC., TO COASTAL WATERS AND GREAT PONDS.
State of Massachusetts, Boston.

Mass Ann Laws Ch 21, Sec 17A (1967).

Descriptors: *Legislation, *Massachusetts, Coasts, Great ponds, Administrative agencies, Natural resources, Recreation, Parks, *Eminent domain, Docks, *Road construction, Land.
Identifiers: Coastal waters.

The Department of Natural Resources is directed, after notice in writing signed by the chairman of the public access board, and with the consent of the governor, to take by eminent domain or to acquire by purchase, lease or otherwise, the land and water areas designated by the board. These lands are to be used to provide public access and related facilities to coastal waters and great ponds. The department is also directed to construct and maintain roads, parking areas, docks, ramps and related facilities as the public access board may designate. The cost of the acquisition, construction, and maintenance is chargeable to the public access fund. (Watson-Fla)
W69-01295

SCHLOOP V NEW YORK)LIABILITY FOR FLOOD DAMAGE(.

190 NYS 2d 96-99 (Ct cl 1959).

Descriptors: *New York, Judicial decisions, *Flood damage, Lakes, Inland waterways, *New York State Barge Canal, Legislation, Dams, Water levels, Navigation, Gates, Outlets, Reefs, *Flood control.

Plaintiff claims damages alleged to have been caused by waters overflowing Oneida Lake. Oneida Lake and its outlet are part of the Barge Canal system. The question is whether there is liability for the damage. Damages caused by a public improvement, such as a canal, are not recoverable in the absence of trespass or negligence. At the close of the navigation seasons the Taintor gates were open wide in the lake outlet. There were no works or construction by the state restricting the flow of water. The restriction was caused by a natural formation, the Caughdenoy reef. The state had no obligation to remove this reef. Claimant's land would have been flooded if nothing had been done by the state. Since the state was using the lake and outlet for canal purposes only, the state was under no obligation to exercise flood control. Since there was no negligence or trespass by the state, claimant cannot recover. (Childs-Fla)
W69-01325

REED V NEW YORK)FLOOD DAMAGE(.
State of New York, Albany.

188 NYS 2d 760-761 (Ct cl 1959).

Descriptors: *New York, Judicial decisions, *Flood damage, Flood control, *Canals, *Culverts, Pipes, Water levels.

After a rainstorm, the water in an unused portion of a canal overflowed the banks causing damage to the property of claimants. The state had filled in the canal bed at one place to provide a roadway over the canal. Two pipes were placed under the roadway to provide for the flow of water. The state had notice of overflowing after the filling of the canal bed. The court found that the state failed to exercise ordinary care and maintenance by reason of the culverts either being clogged or inadequate. If the culverts were open and the state failed to open the gate valve to the lower level of water in the dam below, then they failed in their duty of reasonable care. Judgment was entered for claimants. (Childs-Fla)
W69-01326

VALIDITY OF PROHIBITION OF BATHING, SWIMMING, BOATING, FISHING, OR THE LIKE, TO PROTECT PUBLIC WATER SUPPLY,
C. C. Marvel.
56 ALR 2d 790-796.

Descriptors: *Legislation, Administrative agencies, *Regulations, Boats, Fishing, Swimming, Public health, Judicial decisions, *Water supply, Water quality, Water utilization, Condemnation, Ownership of beds, Riparian rights, Water rights, Water law.

The validity of statutes, ordinances, or administrative regulations which regulate or prohibit boating, fishing, or swimming in any kind of waters, public or private, in order to protect public water supplies is questioned. As applied to members of the general public, such regulations have been generally upheld as a valid exercise of the police power. Where such regulations adversely affect private rights, whether dependent upon the ownership of the bed, or upon riparian ownership, the courts have been divided in their decisions with respect to the validity of such prohibitions. If there is a substantial infringement on the individual's riparian rights the courts generally require the state to resort to a condemnation action and compensate thw owner for such loss. The validity of such regulations is also affected by any reservation of rights, or failure to reserve rights, by one granting water rights to a public agency. (R. Smith-Fla)
W69-01336

JOHNSON V IOWA STATE HIGHWAY COMM'N)SUIT TO RESTRAIN COMMISSION FROM BUILDING 5 PAVEMENT INTAKES WHICH WOULD DIVERT SURFACE WATER ONTO PLAINTIFF'S LAND(.
State of Iowa, Des Moines.

94 N W 2d 773-778 (Iowa 1959) 6 p.

Descriptors: Judicial decisions, *Iowa, Roads, Administrative agencies, Surface waters, *Surface runoff, Highways, Road construction, Diversion, Paving, *Intakes, Damages, Drainage systems, Legislation, Natural flow doctrine, Culverts, Ditches, Erosion, Spillways.

Landowners brought actions against the State Highway Commission which was widening and repairing a highway, to restrain allegedly illegal diversion of surface water onto the plaintiffs' land through five pavement intakes. The trial court entered decrees closing 3 intakes on one side of the road but refused to close the 2 intakes on the opposite side of the road. This court affirmed, stating that the construction of the drainage system will turn the natural drainage of some of the surface water, to the injury of the plaintiffs, and will thereby violate the defendants' statutory duty to drain the surface water from public raods in its natural channel. On this basis the court affirmed the closing of 3 of the intakes. The other 2 intakes would cost additional surface water on the plaintiffs' land but not enough to justify greater relief. It was also noted that it appears to be customary and in harmony with good engineering practices and definitely in the interests of the traveling public to place intakes and spillways where they will quickly take the accumulations of water off the pavement. (Watson-Fla)
W69-01340

BROWN V SCHOOL DIST)DAMAGE BY DIFFUSED SURFACE WATER(.
161 S E 2d 815-817 (S C 1968).

Descriptors: *South Carolina, *Surface runoff, *Surface drainage, Local government, Judicial decisions, Cities, Drainage, Damage, Water injury, Eminent domain, Surplus water, Precipitation excess, Storm drains, Water law, Surface waters, Legislation.
Identifiers: Catch basins, Streets, Just compensation, Cause of action.

This was an action by landowners asking actual damages for allegedly causing surface waters to be wrongfully concentrated and discharged onto plaintiffs' land. The school district built a school building across the street from plaintiffs' house. Plaintiffs' alleged that the construction of this building concentrated and discharged surface waters across the street and onto plaintiffs' property, and that the city did not provide proper drainage along the street as required by statute. The complaint admitted that the city had installed a catch basin in the street, but alleged that it was inadequate to handle all the water. The court held that the complaint stated a cause of action against the school district but not the city. Action by the city did not cause plaintiffs' injury. Action by the school board under statutory authority which effectively destroys or impairs the usefulness of private property amounts to a taking requiring just compensation. (Kirkconnell-Fla)
W69-01342

STATE V PENNSYLVANIA RR)LOCATION OF MEAN LOW WATER MARK(.

244 A 2d 80-85 (Del 1968).

Descriptors: *Delaware, *Low water mark, *Boundaries (Property), Water courses (Legal), *Water level fluctuations, Ownership of beds, Tidal effects, Legal aspects, Judicial decisions, Surveys, Land fill, Railroads.
Identifiers: Burden of proof.

The defendant railroad had filled in land bordering the Delaware River. The question presented was whether the defendant railroad had filled beyond the mean low water mark. The State of Delaware claimed that on the basis of surveys made in 1942 and 1954 the defendant had filled some areas beyond the mean low water mark and thus title to this land was in the state. The defendant claimed that the state had the burden to prove the accuracy of the earlier surveys by a preponderance of evidence. The court held that the 1967 survey was more accurate and the state had failed to establish the accuracy of the earlier surveys. The present coastline must be used where it is exceedingly difficult or impossible to determine the mean low water mark of the distant past. (Kirk-Fla)
W69-01345

ANDERSON V SUPER)OBSTRUCTION OF A DRAINAGE EASEMENT(.

28 111 2d 319, 192 N E 2d 339-341 (1963).

Descriptors: *Judicial decisions, Legal aspects, Water law, Remedies, *Natural flow doctrine, *Obstruction to flow, Surface runoff, Drainage, *Illinois.

Plaintiffs, alleged owners of a dominant heritage, enjoying a perpetual easement for drainage in a natural watercourse, brought suit to restrain the owners of the alleged servient estate and persons who they allowed to dump fill upon their land from further impairing the flow of surface water from plaintiff's land. The complaint alleged that the obstructions on defendants' land caused water to accumulate on plaintiff's land. A mandatory injunction was also prayed for to order defendants to remove the fill and a house and garage. At trial, the chancellor found for defendants. On appeal to the Supreme Court, affirmed. This case turned on the question of fact whether the drainage from plaintiff's land was obstructed by the fill and structures on defendant's land. Where there is conflicting evidence, and it is heard in open court, the chancellor's ruling based thereupon will not be disturbed unless clearly against the manifest weight of the evidence. (R. F. Williams-Fla)
W69-01355

MIDGETT V NORTH CAROLINA HIGHWAY COMM'N)CONTINUING NUISANCE AS A PUBLIC TAKING(.
260 N C 241, 132 S E 2d 599-609 (1963).

Descriptors: North Carolina, Eminent domain, Civil law, Natural flow doctrine, *Road construction, *Effects, Riparian rights, Riparian land, Appropriation, Water pollution, Flood damage, *Surface waters, Sea water, Atlantic Ocean.
Identifiers: *Nuisance (Legal aspects).

The construction of a highway by defendant highway commission constituted a dam which prevented ocean waters that for many years had come over dunes in time of storm from being dissipated toward sound and which caused great quantities of water to inundate the property of plaintiff. The judgement for the defendant was reversed because defendant's construction was an appropriation of land for public use. North Carolina does not apply the common enemy doctrine to surface waters, but applies the Civil or Natural Flow Doctrine. The effect of the highway was to create a private nuisance. It was a jury question as to whether or not defendant might reasonably have anticipated storm or flood. A continuing nuisance maintained by government which substantially impairs private property values is a taking in the constitutional sense. (Crabtree-Fla)
W69-01359

HEWITT V CHICAGO B ANDQ RY)OBSTRUCTION TO FLOW CAUSING FLOODING(.

426 S W 2d 27-33 (Mo 1968).

Descriptors: *Flood damage, Floods, Obstruction to flows, Streamflow, Riparian rights, Riparian land, Levees, Water law, Legal aspects.
Identifiers: Evidence.

The plaintiffs brought action for damages from flooding caused by defendants' railroad bridge which was alleged to have been constructed without suitable openings. The court held that the evidence was sufficient for the jury to find that the flood damage in 1964 was caused by the defendants' bridge. There was a lack of evidence, however, to establish that the bridge was the cause of flooding in 1960 through 1963. Where an obstruction of a watercourse causes annual or occasional flooding of lands, each repetition of overflow gives rise to a new cause of action. (Horner-Fla)
W69-01366

TURNER V ROSS)DAMAGES FOR INCREASING FLOW OF SURFACE WATERS(.

115 Ga App 507, 154 SE 2d 798-801 (1967).

Descriptors: *Georgia, Natural flow, Judicial decisions, Remedies, *Surface runoff, *Surface drainage, Riddance (Legal aspects), Drainage water.
Identifiers: *Damages (Legal aspects), Dominant estate, Servient state, Remedies (Legal aspects).

This was a suit for damages by the owner of a servient lot against the owner of an adjoining dominant lot for maintaining an abatable nuisance. Defendants graded the dominant lot in such a way that it increased the natural flow of surface water onto plaintiff's lot, causing silting of plaintiff's lot and flooding of his basement. The main issue was the proper amount of damages. There was conflicting testimony from the plaintiff as to the amount of damage to his property, and during the course of the trial plaintiff's counsel stated that in this suit the plaintiff could not recover future and permanent damages. The court held that the plaintiff's testimony must be strictly construed against him as to the amount of damages, and that the statement of plaintiff's counsel estopped plaintiff from recovering damages for permanent dimunition in value of his property. (Kirkconnell-Fla)
W69-01367

CENTRAL INDIANA RY V MIKESELL)DAMAGES FROM EMBANKMENT COLLAPSE(.

221 NE 2d 192-201 (111 App Ct 1966).

Descriptors: *Storm runoff, Drainage, Tile drainage, Rainfall intensity, Storms, *Damages, Washouts, Legal aspects, Collapse, Embankments, Probably maximum precipitation, *Excessive precipitation, Culverts.
Identifiers: Railroad embankment, Anticipated rainfall.

A 15 foot high railroad embankment running along the back of plaintiff's residential property gave way during a heavy downpour. The railroad maintained two tiles totaling 20 feet of opening for the passage of water through the grade. The street running along the front of plaintiff's lot had a drainage pipe with a 19.5 foot opening. Defendant's argument that layer openings under the grade would have caused damage, and that water upon plaintiff's land prior to the break caused the damage, were rejected because the damage was cause by the sudden spurt of water from the break in the embankment. Even though the size of the downpour was unusual and extraordinary, there was sufficient evidence for the jury to determine that the exercise of reasonable skill and foresight should have led to its being anticipated. There was evidence that such rains occurred with a frequency of from 20 to 100 years, and that defendant's opening were insufficient. Damages of $2,628 were allowed to compensate for the loss of plaintiff's garage, tool shed, flower garden, family snapshots, driveway and fence, and damage to the foundation and basement of the house. (McDermott-Fla)
W69-01375

LOWE V LOGE REALTY CO)NATURAL WATERCOURSE AND DIFFUSED SURFACE WATER DISTINGUISHED(.

214 N E 2d 400-403 (Ct App Ind 1966).

Descriptors: *Indiana, Natural streams, *Drainage water, Surface waters, Surface runoff, Repulsion (Legal aspects), Obstruction to flow, Intermittent streams, Legal aspects, Judicial decisions, Relative rights, Alteration of flow, Riddance (Legal aspects).

Plaintiff alleged that the defendant was building roads and storm sewers which collected large quantities of rain water and snow water and discharging them on plaintiff's land. Defendant counterclaimed and alleged that there was a natural watercourse across plaintiff's land, and that any flooding of plaintiff's land was the result of obstructions placed in the watercourse by the plaintiff. The Indiana appellate court held that where surface water begins to flow in a definite direction in a regular channel with well-defined banks and bottom, and the flow is from time immemorial and for a substantial period each year, a natural watercourse exists. A landowner can prevent surface water from running on his property by erection of barriers, but where, as here, there is a natural watercourse he cannot barricade it so as to cause damage to another. The plaintiff would be entitled to relief only where the defendant by artificial means so increased the volume of flow as to damage the plaintiff, since the defendant had the right to reasonably divert the flow of surface water into a natural watercourse. (P. N. Smith-Fla)
W69-01380

GARFIELD V EAST PATTERSON)INCREASING FLOW OF SURFACE WATERS(.
47 N J 195, 219 A 2d 865 (1966).

Descriptors: *New Jersey, *Overland flow, *Surface runoff, Judicial decisions, Floods, Local government, Cities, Flood damage, Watercourses (Legal), Natural streams, Surface drainage.

This was an action by a city against numerous defendants, including the State Highway Department and the New Jersey Highway Authority for periodic flooding of a natural watercourse. The city's contention was that with development of the area by defendants, water which would have found its way slowly to the watercourse was now sped on that course by paving and other improvements; and thus the propensity for flooding was intensified. Judgment was properly rendered for the several defendants where, upon the record made, a court could not possibly assess responsibility, if any, of any of the governmental defendants. (Kirkconnell-Fla)
W69-01386

SHERRILL V NORTH CAROLINA STATE HIGHWAY COMMISSION)OBSTRUCTION TO FLOW OF SURFACE WATER(.
264 N C 643, 142 S E 2d 653-657 (1965).

Descriptors: *North Carolina, Damages, *Culverts, Easements, Legal aspects, Eminent domain, Judicial decisions, Watercourses (Legal).
Identifiers: Constiutional law.

Plaintiffs brought an action against defendant Highway Commission for damage to their property. The commission was responsible for maintenance of a culvert which allowed waters of a creek to pass under a highway and by part of the plaintiffs' property. Due to an increased volume of drainage water, heavy rains, and the fact that the angle of the culvert did not follow the natural course of the stream, the foundation of the plaintiffs' store and other property was damaged. The Supreme Court of North Carolina, overruling a lower court, held that these facts were sufficient to establish that the continued maintenance of the fill, culvert and highway constituted a permanent taking in the constitutional sense as of the time that the bank of the creek had washed away up to the plaintiffs' property. Subsequent to this time an easement to discharge water against plaintiff's property was taken, which would also require compensation. (Patterson-Fla)
W69-01390

COMMONWEALTH V THOMAS)RIPARIAN RIGHT OF ACCESS(.

427 S W 2d 213-218 (Ct App Ky 1967).

Descriptors: *Kentucky, Legal aspects, Judicial decisions, Riparian rights, *Eminent domain, Compensation, Riparian land.
Identifiers: Right of access.

In this case landowners seek to recover for loss of access to a lake by reasons of construction of a

roadway and fill across an inlet of the lake bordering on the landowner's property. The court held that riparian landowners have the right of a reasonable access to the entire body of water on which their land borders. This right of access has value, and before the state can take or impair such right it must pay just compensation to the owner for it. (P. N. Smith-Fla)
W69-01395

EFFECT OF URBAN GROWTH ON STREAMFLOW REGIMEN OF PERMANENTE CREEK, SANTA CLARA COUNTY, CALIF,
E. E. Harris, and S. E. Rantz.
U S Geol Survey-Water Supply Paper 1591-B, 1964. 18 p.

Descriptors: *Storm runoff, *Land use.
Identifiers: *Urban drainage, Surface permeability.

Evidence that volume of storm runoff produced by rainfall on valley floor has increased substantially as result of urbanization; increase in outflow is attributed to fact that urban development during period 1945 to 1958 increased extent of impervious surface in product area from about 4% to 19%.
W69-01571

4D. Watershed Protection

LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
Iowa University, Iowa City.
Charles Campbell, N. William Hines, and Marshall Harris.
Monogr 6, Cool Law, Univ Ia, Sept 1965. 45 p, 1 fig, 1 map, 3 tab, 13 ref, append. OWRR Project A-010-Ia

Descriptors: *Legal aspects, *Watersheds, *Iowa, Hydrology, History, *Water laws, Soil erosion, Soil conservation, Flood control, *Small watersheds, Local governments.

The monograph covers the historical aspects, Federal and Iowan of watershed protection and flood control laws, discusses the operation of the Small Watershed Program in Iowa, local sponsoring organizations, and makes recommendations as to the utilization of various local sponsoring organizations. It is meant to create awareness and provide sufficient detail concerning operation of the Small Watershed Program for rural and urban Iowans, Iowa attorneys, and others who guide community decisions.
W69-01255

JOHNSTON V STAPLES)CREATION OF WATERSHED DISTRICT(.
408 S W 2d 206-207 (Ky ct app 1966).

Descriptors: *Kentucky, Water conservation, Remedies, Judicial decisions, Federal government, Legal aspects, Taxes, *Watershed management, Water districts.
Identifiers: Conservation districts.

In an action challenging the validity of a watershed conservancy district's creation and to prevent making of an exploratory survey to determine feasibility of creating such a district, summary judgment was granted for defendant. Appellants are seeking to test the correctness of the trial court's refusal to accept their amended complaint alleging that much of the land within the district belonged to the U S government and was not subject to taxation as required by the statute creating conservancy districts. This court found that while the statute does provide that all property within a district shall be taxed the statute should be read to carry out legislative intent. The intent was only to tax property subject to tax. In any event the U S government had not complained of the inclusion of its land within the district and appellants could not do so. The trial court did not abuse its discretion in refusing the amended complaint. (Kahle-Fla)
W69-01313

INTERSTATE WATERSHED COOPERATION ACT.

Arkansas Laws Act 31 (1967).

Descriptors: *Arkansas, Legislation, Water districts, *Watershed management, Water management (Applied), *Water resources development, Local governments, Assessments, Administrative agencies, *Cooperatives, *Interstate compacts, Project planning.

This act was passed to give local improvement districts the power to participate in interstate watershed projects. It enables the districts to take advantage of federal assistance in this area. The act authorizes the governing authority in each improvement district to enter into agreements with other improvement districts both in Arkansas and in adjoining states, for the purpose of planning, constructing operating and maintaining improvements in interstate watershed projects. The districts are also given the power to levy taxes to fulfill that district's obligations in any such agreements into which it might enter. (Sisserson-Fla)
W69-01335

COSTLEY V LONG)DAMAGES FOR DIVERSION OF STREAM(.
112 Ga App 758, 146 S E 2d 153-155 (1965).

Descriptors: *Georgia, Legal aspects, Judicial decisions, *Alteration of flow, Streamflow, Diversion, Streams, Erosion, Stream erosion, Relative rights, Flood damage, Water injury.

This is an action between adjoining landowners in which the plaintiff sought to recover damages for diversion of a stream on defendant's land which caused water to stand on plaintiff's land and which caused erosion of his land. The Georgia Court of Appeals held that a landowner can change the course of a stream running through his property, provided that he return it to its original channel before it leaves his property and so long as the change does not injure or unduly interfere with any other landowner. When this change of course results in flooding and erosion of plaintiff's land, he may recover for the diminution of fair market value of his land caused by the defendant's actions. (P. N. Smith-Fla)
W69-01381

EVALUATION OF MULCHES FOR WATER-EROSION CONTROL,
N. P. Swanson, A. R. Dedrick, and H. E. Weakly
Trans Amer Soc Agric Eng, Vol 8, No 3, pp 438-440, 1965. 3 p, 5 tab.

Descriptors: Arid climates, Stubble mulching, *Mulching, Organic matter, Water conservation, *Erosion control, *Rainfall intensity, Hay, Rates of application, Asphalt, Runoff.
Identifiers: Plots, Straw.

Objectives of a water erosion study conducted at Lincoln, Nebraska, were: (a) to compare the relative effectiveness of prairie hay, wheat straw, woodchips, and an asphalt emusion in protecting a soil surface against water erosion and (b) to determine the most effective method of anchoring organic materials for stabilizing soil surfaces against water erosion. Three high rainfall intensities were used to check the effect of runoff and sediment load from the plots. A 1/2-ton-acre prairie hay mulch anchored by an asphalt emulsion applied at 1 quart per square yard provided the best protection against water erosion. Prairie hay and wheat straw were comparable in their effectiveness as mulches for protection against water erosion and were more effective than woodchips. Equal amounts of prairie hay mulch applied as a loose mulch or anchored with a disk packer were not significantly different in amount of protection provided against water erosion. Materials and methods used in the study could be applied to arid climates where high rainfall intensities cause water-erosion control problems. (Blecker-Ariz)
W69-01474

CONSERVATION BENCH TERRACES IN TEXAS,
Agricultural Research Service, Bushland, Texas.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-01493

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

EVALUATION OF AN INDEX FOR VIRAL POLLUTION,
Kansas Water Resources Research Institute, Lawrence.
Raymond C. Loehr, and Diann T. Schwegler.
OWRR Research Report A-001-KAN, University of Kansas, Lawrence, pp 1-59, May 1965-June 1966. 59 p, 16 fig, 13 tab, 36 ref.

Descriptors: *Viruses, Water pollution, Waste water, Water treatment, *Water quality, pH, *Sampling, Bacteria, Epidemics, Bacteriophage, Detection, Potable water, Bibliographies, *Evaluation, Waste treatment, Waste water treatment.
Identifiers: Water biology.

Current viral detection techniques rarely are used routinely by health agencies or water treatment personnel to monitor potable and waste water because of the equipment and experience necessary. This report explores the use of coliphage, viruses of coliform bacteria, as a measure of the virological quality of water. Some results of this research are: (1) For routine sampling of water and waste water, the soft agar technique is more precise and less likely to be affected by contaminants than is the filtration method. (2) There is no need for sample preparation prior to detection of the phage except to inhibit phage reproduction between sampling and analysis. (3) The average coliphage concentration in waste water was about 1000 phage/ml. The range of collected data was from 25 to 22,000 phage/ml. (4) The analysis of coliform phage in water and waste water continues to show promise as a routine technique to monitor the virological quality of such waters. (Hess-Kansas)
W69-01232

BIOLOGICAL FIELD INVESTIGATIVE DATA FOR WATER POLLUTION SURVEYS,
Federal Water Pollution Control Administration, Washington, D. C.
William M. Ingram, Kenneth M. Mackenthun, and Alfred F. Bartsch.
Fed Water Pollut Contr Admin Publ WP-13, 1966. 139 p, 51 fig, 5 tab, 467 ref. FWPCA Grant WP 00013.

Descriptors: Biology, *Water pollution, Bioassay, Aquatic life, On-site investigations, *Pollutant identification, Aquatic environment, *Investigations, Bibliographies, *Reviews.

A compilation such as this was first envisioned by the senior author in 1950 during the early years of the national water pollution control program. Over the past 15 years there has been a great demand for biological information as related to water pollution prevention and abatement programs, indicating a need to publish under one cover the natural history aspects of water pollution investigations. Today there are many professions working in water pollution control. All of them can well utilize some basic knowledge of the ecological environment. This book will serve to introduce the non-biologist to the life sciences as they relate to water pollution and its control. The professional biologist, inexperienced in water pollution investigations, will find the book a quick introduction to field studies of polluted streams, lakes and artificial impoundments. For the professional investigator, sources of

further information, both general and detailed, are set forth in the selected references and bibliography to help in his field studies - an underlying feature of the national effort to conserve and protect our water resources. (Author)
W69-01246

ANALYSIS OF NATURAL RADIOELEMENTS IN RAW WATER,
Rhode Island University, Kingston.
Vincent C. Rose.
Final Rep, Water Resour Res Proj A-011-RI, Washington, D. C., June 1967. 5 p, 1 ref.

Descriptors: Water, Ion exchange, Gamma rays, Spectrometers, *Water pollution, Analysis, *Radioisotopes, X-ray analysis, Resins.

Experimental ion exchanger loaded filter papers have been prepared to remove natural radioelements from water. In preliminary studies a mixture of 40% Permutit Q, 30% cellulose and 30% fiber glass gave optimum flow rates for the total removal of potassium. The optimum resin size was 80-100 mesh. In later studies the fiber glass was eliminated to permit x-ray analysis of other trace metals. After studying composition, flow rates, number of passes through the filter and percent removal, a composition of 45% resin (50-100 mesh) was selected. A combination of two papers and multiple recycle was necessary to make the results independent of flow rates. Five milliliter plastic columns containing Permutit Q were prepared to fit in the 5/8 inch well of a NaI crystal. Loading curves were determined for K, Rb, Th and U. Low sample to background rates precluded the use of gamma spectrometry for the analyses of K. and Rb. As little as 0.5 mg of Th and U were detectable with a 40 minute counting time. (Author)
W69-01256

AMENDMENT TO THE SANITARY WATER BOARD ACT OF 1951.
State of Illinois, Springfield.

Illinois Laws ch H 1921 (1967).

Descriptors: *Administrative agencies, *Illinois, Legislation, Administration, Planning, State governments, Programs, *Water pollution control, Water quality, Waste water (Pollution), Standards, Legal aspects, Water law, Water policy, Financing, Government finance, Sewage treatment, Water pollution treatment, Project planning, Pollutant identification.

Section six of the Illinois 'Sanitary Water Board Act' of 1951 is amended by this act. The power of the Sanitary Water Board is extended so that the Board may determine if pollution exists in any of the state's waters, and make orders requiring the discontinuance of pollution activities. The Board is specifically authorized to make findings of fact with respect to violations of the Act, or of the Board's orders; to institute legal proceedings to compel compliance with th Act; to issue or deny permits for the discharge of sewage; and to promulgate standards of quality for the state's waters. Among the duties assigned to the Board are the following: To prepare a comprehensive plan for abatement of present and future pollution, to scrutinize all plans for sewage works and to inspect their construction, and to serve as the state's agency for the receipt of federal funds for pollution abatement. The Board is given the right to enter private property in order to inspect conditions relating to pollution, and to require submission to it of any relevant records or reports. (Pfeiffer-Fla)
W69-01309

A PROBABILISTIC METHOD OF APPRAISING BIOASSAY SAMPLING PROGRAMS,
E I duPont de Nemours And Co, Savannah River Lab, Aiken, S C.
F. Delano Knight, and S. Marshall Sanders, Jr.
Health Phys, Vol 14, No 5, pp 523-524, May 1968. 2 p, 1 fig, 2 ref.

Descriptors: *Path of pollutants, Bioassay, Radioisotopes, Water pollution effects, Water pollution sources, Radioecology, Public health, Radioactivity, Hazards, Probability sampling.
Identifiers: Health physics, Plutonium, Maximum permissible body burden.

A new criterion, developed to appraise coverage of health physics sampling programs of periodic urinalysis, can now be expressed in terms of the probability, P, of detecting an assimilation of D% of maximum permissible body burden in a group of individuals where the fraction of the group, F, is sampled every I days. That probability is defined by the relationship, $P = 1 - (1-F)$ to the mth power $(1-F(n-m))$, where n is the ratio of T/I and m is the number of whole integers in that ratio. Values of T, the length of time when the rate of excretion is above the limit of detection, can be computed from an exponential expression relating E, the quantity of radionuclide excreted per day T days after assimilation, to D and T. That calculation for plutonium takes the form, $T = (2.0424D/E)$ to the 1.3 power.
W69-01425

5B. Sources of Pollution

BAND DIFFUSION WITH VARIABLE PARAMETERS ALONG FLOW,
Syracuse University, New York.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-01238

WATER POLLUTION - NATURE, EFFECTS, TREATMENT, ALTERNATIVES TO TREATMENT.

pp 5-17 of Entry No. W69-01269 in 05G.

Descriptors: Biochemical oxygen demand, Chemical wastes, Decomposing organic matter, Domestic wastes, Farm wastes, Industrial wastes, Organic wastes, Oxygen sag, Nitrification, *Pollutant identification, Pollutants, Radiological wastes, *Water pollution, *Water pollution effects, Water pollution sources, *Water pollution treatment, Pollution abatement, Water treatment, Sediments, Public rights.

A summary of the physical aspects of water pollution and the technical devices available for its abatement is presented. Various classification systems are discussed, but it is concluded that these tend to obscure the complex phenomena that occur in a stream. The primary effects of water pollution are discussed. These are recreational and aesthetic effects, effects on domestic supplies, effects on industrial supplies and the establishment of a technical link between economic units. Methods of treatment are discussed with emphasis on the broad range of alternatives available. It is concluded that value considerations must be introduced into the decision making process and that public intervention is justified. (Pfeiffer-Fla)
W69-01270

RESSLER V GERLACH)NEGLIGENT WELL CONTAMINATION(.
State of Pennsylvania, Harrisburg.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-01284

DISPOSAL OF GARBAGE AND REFUSE ON HIGHWAYS, PRIVATE PROPERTY, OR IN COASTAL OR INLAND WATERS; PENALTY.
State of Massachusetts, Boston.

Mass Ann Laws Ch 270, Sec 16 (1967).

Descriptors: *Massachusetts, Legislation, *Domestic wastes, *Inland waterways, *Coasts.
Identifiers: Crimes.

Whoever disposes of any rubbish in coastal or inland waters, salt or fresh, or within twenty yards of such waters shall be punished by a fine of not more than $50. If a motor vehicle is used, the registrar of motor vehicles may suspend the violator's drivers license for not more than 30 days. If the violator is the owner of the car which was used, his certificate of registration may be suspended for not more than 30 days. (Williams-Fla)
W69-01289

PHOSPHORUS CONTENTS OF SEWAGE-POLLUTED WATERS,
Indian Inst of Science, Bangalore, India.
E. G. Srinath, S. Sathyanarayana Rao, and S. C. Pillai.
Indian J Exp Biol, Vol 4, No 2, pp 114-119, 1966. 6 p, 9 tab, 42 ref.

Descriptors: *Eutrophication, *Water pollution sources, Nutrients, Phosphates, Activated sludge, Sewage, Protozoa, Aeration, Ponds, Rivers.
Identifiers: India, Epistylus.

Soluble phosphates in relatively high concentrations characterize sewage-polluted waters. Values for phosphorus concentrations in some polluted water from Indian rivers and ponds range from 1.7 to 3.1 mg/1, of which 71-90% is in soluble form. When sewage samples are diluted with tap water in different proportions and these samples are allowed to stand or are artificially aerated for 15 days, amounts of soluble phosphate in the supernatant liquids are not appreciably altered. Activated sludge with associated protozoa (principally Epistylus) removed about 85% phosphorus from supernates of undiluted sewage after 6-hr aeration, but only about 26% from diluted sewage samples. The reduced removal of phosphate in diluted samples is attributed to lack of other necessary nutrients. To eliminate 2.7 mg/1 of phosphate from effluent of activated sludge process, the following concentrations of chemical coagulants (in mg/1) were found to be required: alum only, 5; lime only, 5; ferric chloride only, 6; alum and lime, 2 each; alum and ferric chloride, 2 and 3 respectively; and lime and ferric chloride, 2 and 3 respectively. Waters unpolluted with sewage may also contain phosphate, depending on the nature and extent of their contamination with other forms of organic matter.
W69-01427

MAJOR SOURCES OF NUTRIENTS FOR ALGAL GROWTH IN WESTERN LAKE ERIE,
Federal Water Pollution Control Admin., Grosse Ile, Mich.
George L. Harlow.
Publication Number 15, Great Lakes Res Div, Univ Mich, pp 389-394, 1966. 6 p, 2 fig, 5 tab, 9 ref.

Descriptors: *Eutrophication, *Lake Erie, *Nutrients, Algae, Water pollution sources, Nitrogen compounds, Phosphates, Great Lakes, Michigan.
Identifiers: Lake St Clair, Rouge River, Huron River, Raisin River, Detroit River, Maumee River.

Due to an excess of nutrients, western Lake Erie has developed prolific blooms of algae contributing to and indicating the accelerated enrichment of this valuable natural resource. Nutrient concentrations and quantities increase as the waters from Lake St Clair pass by the metropolitan complex of Detroit to western Lake Erie. The sources of waste which contribute to these increases are presented, as well as the relative quantities from each waste source. Municipal wastes contribute 89% of total phosphates and 86% of total nitrogen received into Lake Erie from southeast Michigan, whereas the contribution of phosphate from land drainage is a minor factor. Nitrogen runoff from lands contributes more significantly to nutrient loading than does phosphate from the same source. In Lake Erie, concentrations of nutrient compounds closer to the mouth of the Detroit River are higher than at stations further offshore, except in the case of two

offshore stations thought to be influenced by the Maumee River. Results of nutrient determinations from all stations reported for Lake Erie show concentrations greater than those thought to be critical for triggering blooms of algae.
W69-01445

SOURCES OF NITROGEN AND PHOSPHORUS IN WATER SUPPLIES. TASK GROUP REPORT.

J Am Wat Wks Ass, Vol 59, pp 344-366, 1967.

Descriptors: Runoff, *Nutrients, Nitrogen, Phosphorus, *Water supply.
Identifiers: *Urban drainage.

In this second part of Task Group 2610P of the American Water Works Association, the sources from which nitrogen and phosphorus may enter water supplies are reviewed; a bibliography of 63 references is appended. Sources of these nutrients include sewage, synthetic detergents, industrial wastes, compounds used in water treatment, run-off from agricultural and urban areas, wastes from farm animals and wildfowl, rainfall and dustfall, and nitrogen fixation. Some figures showing increases in nutrient content of various rivers and lakes in U.S. are quoted. From the available data, an attempt has been made to estimate the relative significance of the various sources of nitrogen and phosphorus, and the results are tabulated, showing that agricultural run-off is the greatest single contributor of nitrogen and phosphorus to water supplies. The possibility of controlling the amounts of nutrients contributed by various sources is considered briefly.
W69-01497

POLLUTION OF THE RIVER MERSEY.

Effluent and Water Treatment J, Vol 3, pp 217-22, April 1963.

Descriptors: *Storm runoff, *Overflow, Cities, *Water pollution, Bioindicators.
Identifiers: *Combined sewers, *River Mersey, Great Britain.

The chief source of pollution in the River Mersey is from large discharges of trade effluents. The discharge of such wastes into public sewage treatment works would improve the condition of the river substantially. The desirability of treating trade wastes in sewage treatment plants indicates the advantage of centralization of sewage disposal works. Another major source of pollution in urban areas is the premature operation of storm sewage overflows. This frequently happens in dry weather when streams are at low flow. The Mersey River Board has recommended that, where practicable, the overflows would not operate until at least 8 times dry weather flow has been reached. The significance of pollution is evidenced by typhoid, paratyphoid, and Salmonella infections directly from polluted water or indirectly from food contaminated by it.
W69-01501

SECOND QUINQUENNIAL ABSTRACT OF STATISTICS RELATING TO RIVER SURVEYS IN THE TRENT WATERSHED COVERING THE FIVE-YEAR PERIOD 1957 TO 1961)WITH SOME SUPPL DATA FOR 1962(.
Trent River Board.

120 p, map.

Descriptors: *Storm runoff, *Water pollution, Sewers, Overflow.
Identifiers: *Urban drainage.

Data are tabulated from chemical and biological surveys of rivers in the Trent watershed in the period 1957-1962, and the percentage change in composition between 1951 and 1962 is estimated for various sampling points. The condition of the various stretches of watercourses is indicated on a map using a colour-coding scheme. At present, about 80 per cent of the streams in the watershed are reasonably clean and of some use to the community, but there are still about 150 miles of watercourse which are badly polluted. Only 60 per cent of the sewage effluents reach the requirements set by the River Board but the treatment facilities are being improved gradually. Factors contributing to the deterioration of surface waters are discussed, including the delay in constructing water-treatment facilities for new housing and industrial developments, increasing volumes of effluent and increasing abstractions of water (which increase the ratio of used matural water in the streams), and increasing volumes of storm run-off for which there is insufficient sewer capacity, especially in older urban sewerage systems which do not provide capacity for six or even three times dry-weather flow. Where it is not practicable to improve conditions in streams by imposing higher standards for effluents and discharges from storm-sewage overflows, it may be necessary to consider 'farming the river' to ensure the greatest possible degree of self-purification.
W69-01511

ANNUAL REPORTS OF THE SEVERN RIVER BOARD AND THE WYE RIVER BOARD FOR THE YEAR ENDED 31ST MARCH, 1964.
Severn River Board; Wye River Board.

77 and 60 pp respectively.

Descriptors: *Water pollution, *Storm runoff, *Standards, Biochemical oxygen demand, Discharge (Water), Estuaries.
Identifiers: *Suspended solids, Great Britain.

Both these reports contain sections on water resources, fisheries and prevention of pollution. Hydrological surveys are reported for parts of the catchments of the rivers Bewdley and Avon. Abstraction of water irrigation is increasing and the importance of providing bank storage has been emphasized. Results of surveys of the rivers Severn and Avon, certain of their tributaries, and tidal waters are given and discussed in detail in relation to the various sources of pollution and prospects for future improvements. It is planned to make a complete survey of the rivers Wye and Lugg each month, with less frequent sampling of other tributaries, and the first two complete surveys are reported and discussed. It is considered that effluents discharged to the Wye estuary should conform to the normal standards for a grade-one effluent, in view of the character of the river and the mortality of salmon in the tidal reaches nearly every summer. A measure of control has also been extended to estuaries in the Severn River Board area, and an appreciable departure from the normal working standards was possible when determining the required standards for partially-treated sewage and sewage-works effluents. Basic standards for the discharge of effluents to watercourses are also outlined, including those for pre-1951 discharges. In the case of farm waste waters, allowance is made for the self-purification which may take place in the ditch or stream to which the effluent is discharged. With regard to partially-treated storm sewage, the Severn River Board have abandoned the standard limiting the BOD and, apart from specific standards for toxic materials, the strength and quality of these discharges are now controlled by a limit of 100 p.p.m. on the concentration of suspended solids. This standard also applies in the Wye River Board area where the concentration of sulphide is also limited to 1 p.p.m., as hydrogen sulphide. The standard imposed on the discharge of chlorinated water from a swimming pool limited the concentration of chlorine to 0.5 p.p.m., as free chlorine, and also limited the rate of discharge to ensure that there was sufficient dilution available in the receiving stream to avoid the risk of toxicity to fish. Alterations in the treatment and discharge of sewage and trade waste waters are outlined, together with proposals for new treatment plants.
W69-01520

DELWARE ESTUARY COMPREHENSIVE STUDY PRELIMINARY REPORT AND FINDINGS.
Federal Water Pollution Control Admin., Phila., Pa.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-01522

5C. Effects of Pollution

EFFECTS OF WASTES ON RECEIVING WATER--SOME COMPUTATIONAL AND SCIENTIFIC PROBLEMS.

pp 49-56 of Entry No. W69-01269 in 05G.

Descriptors: Biochemical oxygen demand, Alga toxins, Organic wastes, Pollutant identification Pollutants, Quality control, Water pollution *Water pollution sources, Separation techniques *Analytical techniques, Classification, *Model stu dies, Waste identification, Biological properties Physical properties, Waste water (Pollution) Water quality, Water pollution effects, Impaire water quality, Wastes.

Computational and scientific problems involved i determining the effect of wastes on receiving wate are discussed. The need for an efficient and flexibl means of calculation of pollutants is noted an problems involved in devising such a means ar discussed. Two basic problems are presented. Th first is the conceptual problem of devising a mode which comprehends relevant relationships and i amendable to rapid calculation. The second is th determination of the specific numerical effect of change in one variable on the others. It is con cluded that accurate knowledge of physical an biological relationships in water bodies is an esse tial prerequisite to the design and operation of op timum waste-disposal systems. Research geared t exploring a more definitely empirical approach t water phenomena is encouraged.
W69-01273

LIABILITY OF PERSON OBSTRUCTIN STREAM, RAVINE, OR SIMILAR AREA B DEBRIS OR WASTE, FOR DAMAGES CAUSE BY FLOODING OR THE LIKE,
L. S. Tellier.
29 ALR 2d 447-467, 20 p, 103 ref.

Descriptors: *Streams, *Natural streams, *O struction to flow, Bridges, Culverts, Floods, Floo ing, Conduits, Bottom sediments, Waste disposa Riparian rights, Riparian lands, Flood damag Remedies, Watercourses (Legal), Water law Legal aspects.

Generally, the person considered responsible f the obstruction of a natural stream by debris waste is liable for damages to property resulti from the obstruction. The annotation discusses t limitations and variances of this general rule and i application to specific types of situations. T discussion is limited to the obstruction of natur streams but includes situations where the natu streams passes through a culvert or under a bridg The specific situations considered are where a da is caused by debris, where culverts and bridg have become clogged, where the bed of a stream filled by wastes, and where waste is discharged in a stream. (Horner-Fla)
W69-01293

MEASURE OF DAMAGES FOR POLLUTI OF WELL, CISTERN, OR SPRING,
F. G. Madara.
19 ALR 2d 769-783.

Descriptors: *Water pollution, Damages, Le aspects, Cisterns, *Wells, *Springs, Measuremen Identifiers: Permanent damage, Tempora damage.

The general measure of damages for permanent injury by pollution of a well, spring, or cistern is the difference between the market value of the land before injury and after it. An alternative measure sometimes used is the cost of supplying the injured plaintiff with water of equally pure quality of that which he had. Injury which would last for an indefinite period of time could be treated as a permanent injury. For a temporary injury, one that is abatable, the plaintiff is usually allowed that amount which would compensate him for diminution or loss in the value of the use of the well, spring, or cistern during the time the pollution continued, limited in some jurisdictions to the time of the commencement of action and in others to the time of the trial. An alternate method allows the plaintiff to recover the depreciation in rental value of the property while the pollution lasts. If the plaintiff could have removed the cause of the pollution, his damages would only run up to the time when he could have ended the pollution. Special and consequential damages may be recovered as long as they arise directly and proximately from the pollution. Punitive damages have been allowed. The landowner could also recover expenses occasioned as a result of the pollution, such as purifying a well or getting a new one. (Sisserson-Fla)
W69-01297

MEASURE AND ELEMENTS OF DAMAGES FOR POLLUTION OF A STREAM,
W. R. Habeeb.
49 ALR 2d 253-314.

Descriptors: *Judicial decisions, *Damages, *Water pollution, Reasonable use, Value, Market value, Depreciation, Economic rent, Water utilization, Odor, Trees, Crops, Recreation, Boating, Swimming, Fish, Livestock.

Elements to be considered when measuring damages for stream pollution are examined. Where permanent or irreparable damage results, recovery may be had for the depreciation of market value of the property. However, where the damage can be remedied at a cost lower than the loss in market value, the cost of such repair becomes the measure of damages. Where the pollution is temporary or abateable, the measure is the depreciation in the rental or usable value of the property. Special damages may also be recovered, as may punitive damages, depending upon the particular circumstances. Particular items of damages such as impairment of use and enjoyment of property, noxious odors, discomfort and inconvenience, sickness, trees, crops, deprivation of use of water, recreation privileges, fish, death and injury of livestock, injury to business, expense of repairing injury, fencing, procuring water, expense of mill operations, and others are also examined. (S. Scott-Fla)
W69-01338

THE RELATION OF WATER QUALITY TO WATER USERS,
Resources for the Future, Inc.
Allen V. Kneese, and Blair T. Bower.
In Managing Water Quality, Baltimore: Johns Hopkins Press, 1968, Chap 3, p 31-41, 1 fig, 10 ref.

Descriptors: *Water quality, Domestic water, Water quality control, Non-structural alternatives, Water use, Irrigation water, Industrial water, Aesthetics, Recreation, Aquatic environment, Water treatment, *Water pollution effects.

Determining the effects of various levels and time patterns of water quality on different uses is a critical component of water quality management. With increasing population and rising production of goods and services, there is a concomitant increase in the production and discharge of water that have impacts on the quality of receiving waters. Even under natural conditions water may require modification for certain uses. Water quality necessary for aesthetic and recreational uses is defined. The effects of discharges of various substances on aquatic life have been the subject of many investigations with a wide variation in results. The factors that contribute to this are discussed. The amount and character of water treatment before domestic water use are related to the quality of water intake. Various aspects of this problem are briefly reviewed. Delineating the effects of the quality of water used for irrigation is more complex. Although water quality deterioration is reflected in crop yields, the extent to which crop yields are reduced is a function of a host of interrelated factors. The range of water qualities utilized in industrial operations is wide, depending in part on whether the water is to be used for processing, cooling, or sanitary purposes. These uses are discussed and some possible economical procedures put forth. (Gargola-Chicago)
W69-01400

PRODUCTION RATE, POPULATION DENSITY, AND DRIFT OF A STREAM INVERTEBRATE,
Minnesota Univ., St. Paul.
Thomas F. Waters.
Ecol, Vol 47, No 4, pp 595-604, Summer 1966. 10 p, 6 fig, 3 tab, 32 ref.

Descriptors: *Aquatic productivity, *Indicator organisms, *Productivity, *Mayflies, *Drifting (Aquatic), Streams, Invertebrates, Minnesota, Carrying capacity.
Identifiers: Baetis, Gammarus.

Production rates of stream mayfly, Bactis vagans, estimated by two different methods (growth method and drift method), were compared and related to population density and drift rate. Greater confidence is placed in estimate of productivity from growth. In the year of study, this mayfly had two summer generations and one winter generation (mean annual population density, 1.3 g/sq m). The two production rate methods yielded estimates of 9.1 and 12.6 g/sq m/year as the sum of the three generations; both estimates were minimal. Production rates for summer generations were higher than for winter generation, although winter production was still at a significant level. A linear relationship between drift and production was not demonstrable. Summer generations drifted in large quantities, up to about 22 g/day, but winter generation appeared to drift little, if any, until near the end of the generation in early spring. Ratio of annual production rate to mean population density, or turnover ratio, was 9.7, or 3.2 times the number of generations. Biomass of Gammarus in stream studied was 10-100 times greater than that of Baetis. Author includes compilation of turnover rates reported in the literature and discusses factors which influence them.
W69-01430

HEAT DISSIPATION AND INDUCED CIRCULATIONS FROM CONDENSER COOLING WATER DISCHARGES INTO LAKE MONONA,
Wisconsin Univ., Madison. Dept of Civil Engineering.
John A. Hoopes, Robert W. Zeller, and Gerard A. Rohlich.
February 1968, 213 p, Grant 133-5371, Engineering Experiment Station - 35.

Descriptors: *Thermal power plants, *Thermal pollution, Heat budget, Water pollution sources, Water pollution, Lakes, Wisconsin, Currents (Water), Winds, Meteorology, Mixing, Mathematical models, Thermal radiation, Jets, Circulation.
Identifiers: Lake Monona.

On Lake Monona, Wisconsin, two conduits supply cooling water to a steam-generating power plant (190 megawatts) and return heated water to the lake at a maximal rate approximating 243 cfs. At shoreline, outfalls discharge horizontally at temperatures 10 deg C greater than those of the lake. A floating baffle limits the extent of open water during winter months. Mechanisms of heat dissipation and velocity patterns resulting from heated discharges were studied by undertaking field surveys of temperature and velocity distributions in the lake seasonally and by developing mathematical models for prediction of observed temperature and circulation patterns. During non-winter months, warm water spreads as a two-dimensional jet in a surface layer about 3 ft thick. Steady-state, integral mass, momentum, and energy conservation relationships were used to describe mixing and resulting heat dissipation within the lake. Entrainment coefficients and rates of spread of jets depended on current-velocity and assumed values 2-10 times higher than those for quiescent fluid. In winter, mixing inside baffle and thermal transfer across open water surface cooled discharged water to approximately 4 deg C. Surface heat loss, calculated from radiation and temperature measurements, constituted 5-10% of total power plant heat rejection rate.
W69-01448

CLEAN UP OF LAKE MICHIGAN.

Effluent Water Treat J, Vol 8, No 5, p 255, May 1968.

Descriptors: *Water pollution control.
Identifiers: *Combined sewers, *Lake Michigan, Storm sewers, *Sewer separation, *Urban drainage.

Pollution control authorities in the four states bordering Lake Michigan and the Federal Government have signed an agreement with broad powers to correct pollution in that lake. According to this agreement, storm and sanitary sewers are to be separated in new developments and in connection with urban reconstruction projects, unless pollution can be controlled by other techniques. Pollution from existing combination storm and sanitary sewers is to be controlled by July 1977 by separation of sewage before it reaches the waterways.
W69-01500

5D. Waste Treatment Processes

THE OPTIMUM ALLOCATION OF STREAM DISSOLVED OXYGEN,
Johns Hopkins Univ., Baltimore, Md.; Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01217

WATER CONSERVATION IN FOOD PROCESSING PLANTS,
Maine University, Orono.
Matthew E. Highlands, John M. Hogan, and Sadik Al-Hakim.
Rep, Proj No R 1084-9, Univ Maine, July 1966. 9 p, 3 fig, 4 tab, 7 ref, append. OWRR Project A-008-Me.

Descriptors: Water conservation, Water reuse, Potatoes, Water quality, Water requirements, Industrial wastes, Planning, Economics, Economic efficiency, Industrial plants.

A study of water conservation and reuse in potato processing plants indicated approximately 18.8% of total water intake per day could be reused with little or no further treatment. An additional 14.6% of total daily water used could be reused if suspended solids were removed and treatment to reduce microbiological populations was applied. The foregoing applies to a specific plant. Because of wide variations in plant methods, individual plants should be surveyed before recommending water reuse.
W69-01265

DEFICIENCIES IN TECHNICAL AND ECONOMIC KNOWLEDGE--DAMAGES, TREATMENT, AND ABATEMENT COSTS.
pp 57-85 of Entry No. W69-01269 in 05G.

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Descriptors: Municipal water, Public health, Water pollution, *Water pollution effects, Water quality control, Sewage treatment, Tertiary treatment, Waste water treatment, Water pollution control, Oxidation lagoons, *Water pollution treatment, Commercial fishing, Economics, Cost analysis, Costs, Economic impact, Recreation, Public benefits, Welfare (Economics), Social aspects.

Some of the more significant aspects of the costs of water pollution and the assignment of water quality constraints where costs cannot be satisfactorily specified are discussed. It is concluded that even though ideal accuracy and certainty of water pollution costs may be unattainable, there has been comparatively little rigorous analysis of costs from the point of view of designing efficient water pollution control systems. Alternative water quality control measures discussed include orthodox sewage treatment plants, stabilization ponds, harvested ponds, and tertiary treatment, alterations of streamflow characteristics and direct recirculation. Determinable costs discussed include the treatment costs for municipal water supplies, damages to commercial fishing, and agricultural costs. Less determinable costs include aesthetical and recreational damages and damages to public health.
W69-01274

AN ACT TO PROTECT THE PUBLIC HEALTH AND TO CONSERVE AND PROTECT THE WATER RESOURCES OF THE STATE.
State of Indiana, Indianapolis.

Indiana Laws Ch 263 (1967).

Descriptors: *Legislation, *Indiana, Sewage treatment, *Administrative agencies, Regulation, *Waste water treatment, Management, Classification, Evaluation, Public health, Sanitary engineering.

Enforcement of this act is placed in the State Board of Health. It provides for classification of all waste water treatment plants. The act requires the examination and certification of all operators of waste water treatment plants as to their competency to supervise the operation of the type of plant operated. The act prescribes the powers and duties of the State Health Commissioner and provides for the promulgation of rules and regulations by the commissioner, with the consent of the State Board of Health, to effect the objectives of the act. Any person, firm, or corporation, both municipal and private, violating any provisions of the act or the rules and regulations adopted is guilty of a misdemeanor and is subject to a maximum fine of $500 for each day of operation in violation of the act or the rules and regulations adopted thereunder. (Watson-Fla)
W69-01305

AN ACT TO AMEND SECS 6111.01, 6111.03, AND 6111.31 OF THE REVISED CODE TO EXTEND TAX EXEMPTIONS FOR INDUSTRIAL WATER POLLUTION CONTROL FACILITIES.
State of Ohio, Columbus.

Ohio Laws ch S 20 (1967).

Descriptors: *Ohio, *Legislation, Pollution, Sewerage, *Treatment facilities, Waste disposal, Grants, *Taxes, Pumping plants, Pipes, Incineration, Permits, Watercourses, Industrial wastes.

Terms defined are: pollution; sewage; industrial waste; other wastes; sewage system; treatment works; disposal system; waters of the state; and industrial water pollution control facility. The powers of the Water Pollution Control Board include: developing water pollution control programs; administering grants; working with other agencies to accomplish pollution control; promoting studies relating to pollution; disseminating information; controlling procedures of the Board; issuring orders after public hearings prohibiting discharge of sewage or other wastes into waters of the state or requiring construction or modification of disposal systems; issuing or revoking permits for wastes discharge or for the operation of disposal systems; instituting proceedings compelling compliance with its orders; controlling industrial water pollution control certificates; certifying to the United States that an industrial water pollution control facility conforms with requirements when required by the Internal Revenue Code; and exercising all incidental powers. The Act provides procedures by which an industrial water pollution control facility may be excepted from personal property taxes, franchise taxes and sales and use taxes. Sections 6111.01, 6111.03, and 6111.31 are amended by this Act. (Childs-Fla)
W69-01312

DEPARTMENT OF HEALTH V PASSAIC VALLEY SEWERAGE COMM'N)DAMAGE BY DIFFUSED SURFACE WATERS(.
242 A 2d 675-684 (Super Ct N J 1968).

Descriptors: *Sewage districts, *Water pollution control, *Sewage effluents, *State jurisdiction, Administrative decisions, Water quality control, New Jersey, Judicial decisions, Treatment facilities, Water pollution treatment, Sewage treatment, Sewage disposal, Chlorination, Public health.

This action was on an order to show cause why defendant should not be directed to comply with orders of the Department of Health to improve its effluent treatment facilities to reduce harm to New Jersey waters. The court held that the Department of Health had jurisdiction over the pollution in Upper New York Bay and was empowered by statute to prescribed corrective improvements in defendant's treatment and demand compliance therewith. Absolute discretion, vested statutorily in defendant to determine the size and capacity of each sewerage works did not extend to the intensity of effluent treatment. Though the statute requiring submission to the Department's regulations was intended to enable the Department to supervise preconstruction waste treatment, except in those areas within the jurisdiction of defendant, it did not prevent the Department from requiring corrective measures by defendant to prevent pollution. The state's entering into a 1910 stipulation with federal authorities regarding pollution controls required of defendant did not preclude subsequent requiring of more stringent controls. Neither costliness nor difficulty of financing relieved defendant of it's obligation to cease polluting the waters. (Storace-Fla)
W69-01341

FINK V BOARD OF TRUSTEES OF S ILL UNIV)INJUNCTION AGAINST SEWAGE DISCHARGE INTO STREAM(.
71 Ill App 2d 276, 218 NE 2d 240 (1966).

Descriptors: *Illinois, *Sewage effluents, *Sewage treatment, *Intermittent streams, Water pollution, Effluents, Judicial decisions, Dams, Sewage disposal, Treatment facilities, Water pollution sources, Water pollution control, Water law.
Identifiers: *Injunction, Treated sewage, Remedies (Legal aspects), Sewage treatment plants.

This was a suit to enjoin construction of an upstream dam on an intermittent watercourse flowing past plaintiff's property and to enjoin defendant from discharging sewage effluent into such watercourse. Defendant placed a dam across one of two branches of the stream to impound a lake. Plaintiff's only complaint about the dam was that it would diminish the flow of water past his property. The court found the plaintiff's damage from the dam to be minimal and denied the injunction as to the dam. Below the dam defendant proposed to construct a sewage treatment plant and discharge treated effluent into the stream. Testimony by engineers disclosed two alternative methods for disposal of effluent from the plant: (1) By direct discharge into the stream; (2) By means of an outfall sewer line to carry off the effluent. At times, due to operational failure of the plant, low quality effluent would flow into the stream. The cour balanced the interests of plaintiff and defendan and granted the injunction against discharge of e fluent into the stream. The injunction was prope even though the damage claimed by plaintiff wa wholly prospective. (Kirkconnell-Fla)
W69-01389

INTERACTION BETWEEN ALUMINUM AN PHOSPHATE IN AQUEOUS SOLUTION,
Rutgers-the State Univ, New Brunswick, NJ, Dep of Soils and Crops.
For primary bibliographic entry see Field 02K.
For abstract, see .
W69-01407

STORM OVERFLOW PERFORMANCE STU DIES USING CRUDE SEWAGE,
P. Ackers, A. J. Brewer, and A. E. Birbeck.
Symp on Storm Sewage Overflows, May 4, 1967.

Descriptors: *Overflow, *Storm runoff, Sewa treatment, *Weirs, *Stilling basins, Flow contr *Design, Discharge (Water).

Experiments were carried out to: (a) determine t difference in composition of storm sewa discharge from an overflow and that passed treatment; (b) compare the performance of the d ferent types of overflow; (c) examine the effecti ness of scum boards; and (d) measure the chang in flow to treatment with increasing total flow each structure. The types of overflow tested we (a) a low double side-weir; (b) a stilling pond; (c vortex; and (d) a high-level side-weir with a po tive flow control. The structures tested we designed to operate under hydraulic conditions nearly identical as possible. The overflows we designed to spill at a discharge to treatment of 1/ the maximum discharge and, with the exception the low side-weir, would limit the flow to treatme to 20% above the first spill discharge. The m practical form seemed to be the round-crest type. Measurements were made of: (a) discharge to treatment at first spill; (b) discharge to treatment and spill at various larger coming flows; and (c) the water levels in the ov flow chamber for these discharges. The high s weir had the best general performance, second w the stilling pond with the scum board 6 in. from crest, and the vortex overflow was the worst.
W69-01494

THE QUALITY OF STORM WEATHER FLOW
Gunnar Akerlindh.
Satryck ur Nordisk Hygienisk Tidskreff, Vol 31, 1, 1950.

Descriptors: *Storm runoff, *Overfl *Coliforms, Sewage, *Water quality, *Biochemi oxygen demand, *Rain water.
Identifiers: *Combined sewers.

The quality of storm-water flow, particularly surplus discharge from combined sewers, discussed in order to compute the required re lated flow; that is, the amount of flow to be diver for disposal. The three elements constituting sto weather flow--namely sewage, ground water, rain water, have been considered. Coliform b teria in samples taken from streets (high ru coefficients) and parks (low runoff coefficie were compared. The concentration of orga matter in rain water is comparatively great (B.O 100 to 200 ppm) being nearly as polluted sewage. In regard to coliform organisms, howe the rain water portion of the storm-weather f has a density of 100 to 1,000 per ml and, cordingly, is much lower than sewage and ha diluting effect on the sewage. The composition rain water flow varies greatly and indefinit Despite this, it is reasonable to assume a cons composition.
W69-01495

NVIRONMENTAL FACTORS IN RELATION O WATER USE AND PROTECTION AGAINST OLLUTION,
ational Inst of Water Research, South Africa.
. R. Allanson, M. R. Henzen, and O. J. Coetzee.
onference on the Problems Associated with the urification, Discharge and Re-Use of Municipal nd Industrial Effluents, Pretoria, 1964, pp 77-92.

escriptors: Drainage, *Chemical analysis, *Water ollution, *Runoff, *Water quality.
dentifiers: Urban drainage, *Bacteriological mpling.

onsideration is given to the conditions on the rainage surface of a catchment area which cause hanges in the chemical and bacteriological quality river water, to factors responsible for the self-pu-fying capacity of streams and rivers, and to iteria upon which the efficient use of South frican rivers should be based. Data are included owing how the physical and chemical quality of rface waters is affected by natural factors (dis-lved and suspended substances in rain water, ac-ss of ground water, and contact with geological rmations), agricultural activities, and run-off om residential and industrial areas.
/69-01496

EWERAGE MANUAL AND DIRECTORY, 963.

anadian Municipal Utilities, 144 p.

escriptors: *Surveys, *Storm runoff, *Water pol-tion, Sewage treatment.
dentifiers: *Canada.

his publication contains a Manual Section (pp. 7-60, 135-138, and 140-141), giving information n various aspects of sewage treatment and sposal; a pictorial review of equipment (pp. 62-9); and a statistical section, giving details of the ewerage systems and sewage works in each rovince of Canada (pp. 91-113). The Manual Sec-on includes articles on air utilization in sewage orks (DUTTON, C. S.), including aerated etritus tanks, aerated channels, and types of quipment for aeration in the activated-sludge rocess; 'package' and 'compact' sewage-treatment lants (GRUNWELL, H.), with illustrated descrip-ons of representative plants, namely the 'Accelo-iox', 'Rated-Aeration', 'Sparjair', 'Oxigest', and Septi-Robic' units, all of which are based on an ex-nded-aeration process, and the 'Simplex' Corner ocket Plant (based on the standard activated-udge process), 'Clarigester' (providing primary reatment and digestion), and 'Oxigritter' (primary reatment); elutriation of digested sludge (SCOTT, . T. G.); problems caused by synthetic detergents BERRY, A. E.), including data on the concentra-ons of these materials in sewage, sewage-works ef-uents, river water, storm water, well water and undries waste waters in Ontario, and the remedial easures taken; pumping in sewerage systems MAC KENZIE, J. A., and TAITERSALL, J. K.); nd instrumentation, control and automation for ewage works (SIMMONS, R. A. G.).
/69-01499

ROGRESS AT COLCHESTER SEWAGE-REATMENT WORKS.

urvr Munic Cty Engr, Vol 127, No 3840, pp 28-9, 1966.

Descriptors: Storm runoff.
dentifiers: *Storage tanks.

rogress on the construction of a new high-level nlet works and on the reconstruction of 2 high-evel storm-water tanks, at the Haven sewage orks, Colchester, is reviewed and illustrated.
/69-01503

WHAT TO DO ABOUT POLLUTION FROM STORM SEWAGE OVERFLOWS.

Wastes Eng, Vol 33, 1962.

Descriptors: *Storm runoff, *Overflow, Outlets, *Chlorination, *Ozone, Design, *Water pollution, Sewage treatment.
Identifiers: *Storm sewers, *Urban drainage, *New York (N. Y.).

In a symposium on the treatment of storm sewage overflows presented by the Sanitary Engineering Division, Metropolitan Section, American Society of Civil Engineers, the subjects discussed were frequency and composition of storm-sewage overflows; the effect of storm-water outfalls on waters around New York City; techniques of analysing and classifying harbour water; sewage and storm-water chlorination; treatment of storm-sewage overflows with ozone; design of facilities for chlorinating storm water; and design and operation of sewerage systems to minimize pollution.
W69-01504

REPORTS ON THE PROGRESS OF APPLIED CHEMISTRY.

London, Society of Chemical Industry, 1963, Vol 48, 800 p.

Descriptors: *Water pollution control, *Legislation, *Storm runoff, Bioindicators.
Identifiers: *Bacteriological sampling.

Progress in the various branches of applied chemistry is reviewed, with a comprehensive list of references appended to each chapter. The following are among the subjects considered. (1) Sewage, trade wastes and river pollution. MC NICHOLAS, J. (pp. 322-333). This review covers legislation to control pollution of surface waters and beaches, and studies on river pollution; effect of polluting materials on fish; storm sewage; percolating filters; activated-sludge process; sludge treatment; effects of synthetic detergents; treatment of trade-waste waters; and instruments for the control and monitoring of sewage-treatment processes. (2) Biodegradability of detergents. DICKER, D. W. G. (pp. 334-342). Current progress in the development of 'biologically-soft' anionic detergent materials and the control of 'hard' materials is outlined, followed by a review of work on the measurement of biological degradability and its relation to molecular structure; studies on non-ionic detergents, since their relative contribution to pollution will increase as biologically-soft anionic detergents come into general use; and studies on the toxicity of surface-active agents and the removal of alkylbenzenesulphonates from waste waters. (3) Microbiology of water, sewage and industrial effluents. ALLEN, L. A. (pp. 532-541). This chapter covers the microbiology of water, especially sewage-polluted water, and of waste-treatment processes, particularly the various modifications of the activated-sludge process and the treatment of carbonization, cyanide, cellulose-manufacture and other trade waste waters. (4) Sampling for bacteriological examination. GIBBS, B. M. (pp. 541-549). Included in this review are sampling devices and techniques for the microbiological examination of water and mud. Other chapters of the report contain information on the disinfection of water by chlorination (p. 566) or ozonation (p. 602), demineralization of sea water using soluble phthalocyanine dyes to increase the rate of solar evaporation (p. 54), and the use of plastic pipes for drinking water (p. 622).
W69-01505

CHICAGO ACTS TO ATTACK COMBINED SEWER PROBLEM.

Civ Eng, Vol 38, No 8, p 99, Aug 1968.

Descriptors: *Storm runoff, Standards, *Manholes, *Storm drainage.
Identifiers: *Chicago (Ill.), *Combined sewers, *Residential sewers, *Urban drainage, Capacity.

The Chicago Metropolitan Sanitary District is planning separate facilities for storm runoff. In the meantime, it has issued an ordinance setting an interim policy for the issuance of permits within a 300-mile area now being served by combined sewers. Provisions of this new ordinance include: only one building drain is required to carry both building wastes and storm water runoff to the combined sewer but municipalities may require separate drains; industries must provide separate services to the control manhole for storm water and industrial wastes; on-site storm facilities for the attenuation of peak flows will be given consideration, but the final determination will be made by the local municipality; and in new construction, downspouting and surface drains to sewers are prohibited unless storm-water capacity has been provided or unless such drainage flows through detention and/or regulating devices.
W69-01512

200 POLLUTERS GET THE WORD EARLY.

Eng News - Record, p 12, Feb 1, 1968.

Descriptors: *Water pollution control.
Identifiers: *Combined sewers, *Urban drainage, *Sewer separation, Lake Michigan.

Included in a recent list of FWPCA recommendations on pollution in Lake Michigan is a statement that combined sewers be prohibited in all new urban areas and separated in all urban reconstruction projects. The recommendations call for the elimination of pollution from combined sewers in 55 cities by 1977.
W69-01513

A REVIEW OF THE LITERATURE OF 1966 ON WASTE WATER AND WATER POLLUTION CONTROL.

J Water Poll Control Fed, Vol 39, pp 689-749, 867-945, and 1049-1154.

Descriptors: *Water pollution control, *Chemical analysis, *Sewage treatment, *Storm runoff, Estuaries, Standards, Legislation.

In a review of literature published during 1966 on waste treatment and pollution control, subjects dealt with include methods of analysis (including automated chemical techniques); physical and chemical methods of sewage treatment; biological filtration; the activated-sludge process; disinfection of sewage; effects of synthetic detergents on sewage treatment and aquatic organisms; biodegradation of detergents; digestion, treatment, and utilization of sludge; recovery and re-use of sewage and trade waste waters as water supplies; design of sewerage systems and treatment of storm sewage; composting of garbage; treatment of specific types of trade waste waters; treatment, disposal, and polluting effects of radioactive waste waters; biological surveys of polluted waters; polluting effects of sewage and trade waste waters; toxic effects of metals, pesticides, and weedkillers; effects of thermal pollution; effects of pollution on the physiology of fish; bio-assay techniques; estuarine and marine pollution; microbiology of polluted waters; oxygen sag and self-purification; quality standards for streams; effects of pollution on water supplies; pollution of ground water; eutrophication of natural waters; use of systems analysis in managing water resources; and legislation controlling pollution.
W69-01514

NINTH ANNUAL REPORT, FOR THE YEAR ENDED DECEMBER 31ST 1963.
Water Research Association.

44p.

URBAN U. W. I. URBANA - CHAMPAIGN

Descriptors: *Coliforms, Chemical analysis, Turbidity, *Computer programs, *Rainfall-runoff relationships, Groundwater recharge, *Instrumentation, Rain gages, *Sewer hydraulics, Pipes.
Identifiers: *Leak detection.

This report on the work of the Water Research Association contains individual sections on biology (development of synthetic media for use in the coliform test and methods for controlling algae); chemistry (coagulation of water, dewatering of water-works sludge, and methods for the determination of free and combined chlorine, turbidity, chemical oxygen demand (to avoid interference by chlorine) and traces of organic chemicals, pesticides, and herbicides); hydrology (particularly the use of an analogue computer to solve problems connected with the relations between rainfall, runoff, and evaporation, estimation of evaporation from catchment areas, and abstraction and artificial recharge of ground water, and development of instruments for measuring rainfall and stream flow); physics (detection of leaks and properties of pipes); and plant processes (coagulation, demineralization, and fluoridation).
W69-01515

HYDRAULICS RESEARCH 1963 AND 1964. THE REPORTS OF THE HYDRAULICS RESEARCH BOARD WITH THE REPORTS OF THE DIRECTOR OF HYDRAULICS RESEARCH.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01516

FIFTEENTH AND FINAL ANNUAL REPORTS OF THE BRISTOL AVON RIVER BOARD AND THE SEVERN RIVER BOARD FOR THE YEAR ENDED 31ST MARCH, 1965.
Bristol Avon River Board; Severn River Board.

46 pp, 2 pl; and 56 pp, 2 pl.

Descriptors: *Water pollution control, Sewage treatment, Data collections, *Standards, *Storm runoff, Sewage effluents.
Identifiers: *Suspended solids, Bristol (Great Britain).

These reports each contain information on water resources and the prevention of pollution, including the characteristics of the water and the treatment of sewage and trade waste waters. Tabulated data are included from surveys of the rivers Severn and Avon and their tributaries; and for the Bristol Avon area, the classification of the watercourses is compared with that reported in 1958. In the Severn area, a high standard has been adopted for settled storm sewage, limiting the concentration of suspended solids to 100 p.p.m. based on the average of three consecutive samples. Owing to the excessive amounts of suspended matter often found in effluents from package sewage-treatment plants, the Severn River Board request that land treatment should be provided for these effluents. Recommendations have also been made regarding the design of oil-storage tanks to prevent pollution caused by accidents or misuse.
W69-01518

NORTHUMBERLAND AND TYNESIDE RIVER BOARD. ANNUAL REPORTS FOR THE YEARS ENDED THE 31ST MARCH, 1962 AND THE 31ST MARCH, 1963.

56 pp.

Descriptors: *Water pollution control, Water quality, *Standards, Sewage effluents, *Overflow, *Storm runoff.
Identifiers: *Storage tanks, *Suspended solids, *Great Britain.

These reports each contain a section on the prevention of pollution, with information on the quality of river water, instances of pollution and fish mortality, and remedial action, including a summary of new and projected schemes of sewage disposal. Average data obtained in analyses of the more important rivers and streams are appended. Standards for sewage effluents and trade waste waters are outlined. A new standard has been imposed requiring that effluents from storm-water tanks at sewage works shall not contain more than 100 p.p.m. suspended solids. It is not, however, considered practical to impose a standard on the storm-water overflows on sewage systems.
W69-01519

ANNUAL REPORTS OF THE SEVERN RIVER BOARD AND THE WYE RIVER BOARD FOR THE YEAR ENDED 31ST MARCH, 1963.

70 pp.

Descriptors: *Water pollution control, *Standards, Sewage effluents, *Biochemical oxygen demand, *Storm runoff, *Overflow.
Identifiers: *Combined sewers, *Capacity, *Great Britain.

These reports each contain sections on water resources, fisheries, and prevention of pollution. The basic standards for effluents are summarized; they have remained unaltered except that, following a decision by the Ministry of Housing and Local Government, no limitation is now imposed on the B.O.D. of discharges of partially-treated sewage or storm water. Progress in the construction of works to alleviate pollution of the Severn river system has been satisfactory but in many cases full advantage of the new sewage works cannot be taken in storm time until improvements to the main sewerage system have also been carried out. A number of sewage authorities have accepted the policy of the Severn River Board for reducing the storm product in combined sewers by the selective elimination of surface water, and the enlargement of main sewer capacities will permit closure of certain overflows. New storm overflows are not permitted except in exceptional circumstances.
W69-01521

NEW YORK STATE MUNICIPAL WATER AND SEWAGE,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01525

CONTROL OF SEWER USAGE AT DETROIT, MICHIGAN,
C. L. Palmer.
Sewage Works J, Vol 18, No 6, pp 1127-9, Nov 1946.

Descriptors: *Standards, Sewage treatment, *Discharge (Water), *Storm runoff, Sewers.
Identifiers: *Detroit (Mich.).

Discussion of 'Standards and Regulations' in Detroit, that are to apply to point where industrial or commercial type wastes are discharged into public sewer; data on sewage treatment facilities and discharge of storm water to Detroit and Rouge Rivers.
W69-01528

STANDARDS AND TECHNICAL SPECIFICATIONS FOR PLANNING SEWERS IN INHABITED LOCALITIES,
A. N. Shevkun.
Vodosn Sanit Tekh, No 3, pp 1-5, 1957.

Descriptors: *Standards, *Sewers, Planning, Design.
Identifiers: *Combined sewers, *Russia.

The author reviews recent Russian regulations concerning the design of separate and combined sewerage systems and sewage works.
W69-01530

FINE SCREENS FOR COMBINED SEWAGE.

Amer City, p 42, Dec, 1967.

Descriptors: *Biochemical oxygen demand, *Over flow, Sewage treatment.
Identifiers: *Combined sewers, *Suspended solids.

A study to determine the feasibility, effectiveness and economics of providing primary treatments t reduce BOD and suspended solids from overflow c combined sewers is outlined. Combined sewag and overflow will pass through two fine-mes vibrating screens each 7 ft. in diameter and one 6 inch horizontal screen.
W69-01533

TESTS CHEMICAL TREATMENT OF STOR OVERFLOW.

Amer City, p 36, Nov , 1967.

Descriptors: *Sewage treatment, *Storm runof *Overflow, Water pollution, *Equipment.
Identifiers: *Storm sewers, *Polymers, *Suspende solids.

Work by Dow Chem. Co. under an FWPCA co tract to determine the effectiveness of chemic treatment of storm-sewer overflow is describe Objectives of the study are: to detail the sequen of events that occurs during and immediately aft storms, particularly the volume and pollution content of the storm water; to determine the val of organic flocculants for the removal of suspend material from storm-sewer overflow; to study t effectiveness of several types of disinfectants in t waste flow; and to design equipment that will ma effective use of chemicals. The polymers used a Purifloc flocculants.
W69-01534

$5,729,103 AWARD FOR WATER POLLUTIO RESEARCH.

APWA Reporter, March 1968.

Descriptors: *Water pollution control, *Overflo *Storm runoff, Sewage treatment.
Identifiers: *Combined sewers, *Storage tan Jamaica Bay (N. Y.).

The FWPCA recently awarded several contra concerned with methods to control pollution fr overflows of combined sewers during storms, cluding an evaluation of a treatment plant for co bined sewer outflows into Jamaica Bay, and co struction and evaluation of a 2 million gallon co bined sewage treatment and storage facility in N Hampshire. Demonstration contracts to find so tions to the combined sewer problem were award and include: a facility to treat wastes by mic screening, and facilities to demonstrate off-sho underwater storage of storm water overflow, fr combined sewers.
W69-01535

TO RESTORE LAKE ERIE BEACHES.

ASCE - San Eng Div, Newsletter, p 6, May, 1968

Descriptors: *Recreation facilities, *Water pol tion control, *Overflow flow control, *Chlori tion, Discharge (Water).
Identifiers: *Combined sewers, *Cleveland (Ohi *Lake Erie, *Interceptor sewers, Capac *Polymers, *Sewer flushing.

Cleveland, Ohio is attempting to restore some of Lake Erie beaches polluted by overflows of co bined storm and sanitary sewers. Methods under vestigation are: (1) the use of polymers to red overflows from the Edgewater sewer by increas the flow-carrying capacity of the Westerly in ceptor sewer; (2) hypochlorination of the ma overflows and creek waters entering Lake Erie; flushing sewers during dry weather to reduce

ischarge of solids when it rains; (4) screening of verflows and streams.
V69-01536

A PLAN TO HELP LAKE ERIE.

ASCE - San Eng Div, Newsletter, p 5, Jan 1967.

Descriptors: *Overflow, *Construction, *Sewage agoon, Sewage treatment.
Identifiers: *Cleveland (Ohio), *Storage tanks, Combined sewers, *Lake Erie.

The feasibility of building a large waste-water hold-ng and treatment reservoir in Lake Erie for com-ined-sewer overflows in Cleveland is being stu-ied. The possibility of building a deep detention acility off the shore of Lake Erie is being in-estigated because of the high cost of acquiring aluable lakefront land there. Construction echniques will be analyzed and the best methods f operation to assure flexibility of use and efficien-y of treatment will be recommended. If this proves o be feasible, the lagoon may provide further treat-ient of the wastes from Cleveland's Easterly econdary-treatment plant and flows from storm ewers in this section of the city.
V69-01537

FEDERAL GRANT TO HELP RESTORE CLEVELAND BEACHES.

Civ Eng, Vol 38, No 6, p 85, June 1968.

Descriptors: *Recreation facilities, *Overflow, low control, *Chlorination, Storm runoff, *Water ollution control, Discharge (Water).
Identifiers: *Combined sewers, *Cleveland (Ohio), Polymers, *Lake Erie, *Sewer flushing, *Inter-eptor sewers, Capacity.

Cleveland, Ohio has received a grant to restore eaches polluted largely by overflows of combined ewers and to expand recreational opportunities for he area. Control and treatment methods to be used n this project include: experimental use of olymers to reduce overflows from the combined ewers by increasing the flow-carrying capacity of nterceptor sewers; hypochlorination of the major verflows and creek water entering Lake Erie; im-lementation of a sewer-flushing program during ry weather to reduce the discharge of solids when t rains; and screening of overflows and streams.
V69-01538

MILWAUKEE SEEKS TO SOLVE POLLUTION PROBLEM.

Civ Eng, Vol 37, No 9, p 79, Sept 1967.

Descriptors: *Storm runoff, *Overflow, *Chlorina-ion, *Chemical analysis.
Identifiers: *Milwaukee (Wis.), *Storage tanks, Combined sewers, *Bacteriological sampling.

Milwaukee will construct a huge underground oncrete tank to catch rainstorm overflow from the ombined sanitary-storm sewer system. The emonstration tank will be 170 ft. long, 130 ft. vide, and 30 ft. deep, and will hold 3.9 million gal-ons. The tank is being designed to catch the runoff, urify it with chlorine, or hold it until the storm nds. Then the runoff will gradually be drained ack into the combined sewer system, which flows o the treatment plant. In addition to this demon-tration project, the quality and quantity of the ombined flow, including a physical, chemical and acteriological analysis of the combined waste, will e made in an effort to determine when the sewers verflow or for how long.
W69-01539

NEW ORLEANS HAS GRANT TO TREAT STORM WATER.

Civ Eng, Vol 37, No 3, p 103, Mar 1967.

Descriptors: *Storm runoff, Recreation facilities, *Water pollution, *Overflow, *Chlorination.
Identifiers: Grants, *Storm sewers, *New Orleans (La.), *Urban drainage.

Lake Pontchartrain beaches now have to be closed after heavy summer rains when storm water, with a high bacterial count, is pumped from the canals in New Orleans into the lake. Although New Orleans has separate storm-water and sewer systems, some overflow from the sewers into the canals carrying rain water does occur. In addition, the canal waters are contaminated by dirt washed off the streets during rains. A demonstration project is being initiated to study the injection of chlorine into storm waters in four open canals discharging into the lake. At one of the chlorine-injection stations a special concrete chamber, 1,300 ft. long, 85 ft. wide, and 14 ft. deep, will be built in a canal to assure that the chlorine will be adequately mixed with the storm waters. The project also involves the construction of a chlorine-blending plant to avoid the potential hazard of using the disinfectant in its gaseous form.
W69-01540

IMPROVEMENTS TO SEWAGE TREATMENT AT BATH.

Civ Eng and Pub Wks Rev, Vol 63, No 738, p 70, Jan 1968.

Descriptors: *Sewage treatment, *Pumping, *Storm runoff.
Identifiers: Capacity.

Modifications to the City of Bath's sewage treatment system include the provision of new storm sewage treatment plant adjacent to their pumping station at Twerton, the plant now being designed to deal with some 17 m.g.d. under storm conditions, while a further 10.5 m.g.d. will be pumped 5 miles through a 30 in. rising main to the main treatment plant at Saltford. In order to connect the new pumping capacity, a temporary pumping was required to handle the full flow of sewage, so that the wet well could be isolated and work on connecting pipe work be carried out. For this purpose, the inlet chamber, measuring 6 ft x 5 ft. was converted to a sump to receive the full flow of sewage and 5 sykes 6 in. Univac pumps, working on a total suction lift of 25 ft. were installed. Normal peak mid-day and evening flows handled by the pumps are of the order of 250,000 gal/hr. With the wet well isolated, the 3 ft. thick dividing wall of the well was cut through using the ladder drilling method with holes at 4 in. centers being cut down by paving breakers to give an opening of some 4 ft. 6 in. square section. Old pipe sections which had to be removed were maneuvered through this opening by chain block and tackle before the new 24 in. dia. suction branches could be replaced.
W69-01541

ELMBRIDGE WATER POLLUTION CONTROL WORKS.

Civ Eng and Public Wks Rev, Vol 62, No 734, p 997, Sept 1967.

Descriptors: *Storm runoff, *Overflow, *Sewage treatment, *Sedimentation, *Sewage sludge, Equipment.

The new sewage disposal works at Cranleigh will deal with sewage flows up to 3 x D.W.F. and all storm flows will be treated in the old works which have been modified. At the storm overflow chamber, flows in excess of 3 x D.W.F. are overflowed to the old works for treatment in the sedimentation tanks, biological purification on four filters and secondary settlement in the humus tanks before discharge to the Cobblers Brook. In order to deal with these storm water flows, the first of the three sedimentation tanks has been equipped with a sludge scraping mechanism and the other two tanks have a ridged floor formed by precast concrete units to facilitate the removal of the sludge settling in these tanks. The old filters have had new revolving distributors fitted and arrangements have been made to trickle feed these filters with settled sewage during dry weather. In this way, the micro-organisms which must be present to effect biological purification will be kept alive and the filters ready to treat the excess flows in wet weather.
W69-01542

TUNNEL WILL STORE STORM RUNOFF.
Eng News Rec, Vol 179, No 22, p 32, Nov 30, 1967.

Descriptors: *Overflow, Storm runoff, Treatment, Pumping, Tunnels.
Identifiers: *Combined sewers, Chicago (Ill.).

Chicago's Dept of Public Works tunnel is designed to hold excess flow from combined storm and sanitary sewer system in area during heavy rains; when rain runoff stops, pumps in tunnel will put sewage back into existing system leading to treatment plants; schematic drawings of tunnel and water diversion from combined line to tunnel.
W69-01543

PLANT WILL HALT STORM POLLUTION.

Eng News Rec, Vol 178, No 7, p 16, 1967.

Descriptors: *Overflows, *Sewage treatment, Solid wastes.
Identifiers: Storm sewers.

A description is given of the proposed system of centrifuging and air injection to be installed at the sewage works of Fort Smith, Ark., to remove solids from storm-sewage overflows which by-pass the works. A study will also be made of the system as part of the normal treatment process, functioning between the bar screens and the primary sedimentation tanks.
W69-01544

SEATTLE SEES VICTORY IN ITS BATTLE AGAINST POLLUTION.

Eng News Rec, Vol 174, No 23, pp 44-46 and 51, 1965.

Descriptors: *Overflows, Sewage treatment.
Identifiers: *Storage tanks, Storm sewers.

The comprehensive sewage-disposal facilities planned for Seattle, Wash., to reduce pollution of Lake Washington and coastal waters of Puget Sound are outlined; the Renton and West Point treatment plants are now in operation. Some pollution is still likely to occur as a result of overflows of storm sewage; one proposal to reduce this is construction of holding tanks near Lake Washington
W69-01545

CITY PLANS TO TREAT STORM WATER.

Eng News Rec, Vol 172, p 22, May 28, 1964.

Descriptors: *Storm runoff, *Chlorination, *Overflow, Recreation facilities, Design, Estuaries.
Identifiers: *Storage tanks, *Storm sewers, Capacity, *New York (N. Y.).

Describes the 'Marginal Pollution Control Program' for New York City in and around Jamica Bay, Eastchester Bay and the Upper East River. Large detention tanks are being constructed with chlorination facilities at the storm sewer overflows. Tanks are designed to capture an estimated 25 of 40 summer storms with 15 overflowing. The initial phase of construction for Jamaica Bay will include 4 storm water detention tanks serving 12,663 acres. The above program is designed for protection of the cities bathing beaches.
W69-01546

UNDERWATER STORAGE OF STORM OVERFLOW.

Environ Sci Technol, Vol 2, No 9, p 668, Sept 1968.

Descriptors: *Overflow, *Storm runoff, Design, *Flowmeter, Sewage sludge, Pumping.
Identifiers: *Combined sewers, *Storage tanks, *Washington, D. C., *Interceptor sewers, Suspended solids.

The feasibility of storing overflow of combined sewers in inflatable tanks anchored to the bottom of a river bed is being studied by a pilot project in the Anacostia River in Washington, D. C. The project is intended to demonstrate that this approach can capture, handle, store, and return overflow to the interceptor sewer without the overflow ever touching the river. The tanks are made of synthetic rubber impregnated with nylon fabric. They measure 120 x 20 feet, and stand between 6 and 7 feet high when inflated. In operation, the system will work this way: storm overflow passes through a Parshall flume where the volume is measured and recorded. At a predetermined level, a butterfly opens to allow influent to enter a grit chamber, where oils and grease float to the top and are skimmed off. The flow passes through a comminutor which shreds all solids down to 3/8 inch. The flow then moves by gravity to the storage tanks. When it is ready to be pumped back to the interceptor, compressed air is used to prevent sludge buildup.
W69-01547

UNDERWATER TANKS WILL STORE RUNOFF WATER.

Environ Sci Technol, Vol 2, No 3, p 169, March 1968

Descriptors: *Storm runoff, *Overflow, Design.
Identifiers: *Storage tank.

Underwater tanks to store excess sewage and runoff waters during overflow conditions will be designed, constructed, and operated by Melpar, Inc. The stored water will be returned to the municipal treatment plant when conditions are more favorable. The tank will be located on the river bottom several hundred feet from shore and will not be a hindrance to navigation.
W69-01548

NEW ORLEANS TRYING DISINFECTION OF STORM-SEWER DISCHARGES.

Publ Wks, N Y, Vol 98, No 3, p 139, 1967.

Descriptors: *Storm runoff, *Chlorination, Recreation facilities.
Identifiers: New Orleans (La.), Storm sewers.

Pollution of Lake Pontchartrain through the discharge of storm sewage from New Orleans into canals, has occurred, leading to closure of the beaches after heavy rains when the canal contents are pumped into the lake. To remedy this, it is planned to chlorinate the storm sewage in the canals.
W69-01549

MILL GREEN SEWAGE DISPOSAL WORKS EXTENDED.

Survr Munic Cty Engr, Vol 129, No 3912, pp 27-28, 31, 1967.

Descriptors: *Storm runoff, Treatment.
Identifiers: Storage tanks.

An illustrated description is given of recent extensions to the Mill Green sewage works of Hatfield R.D.C., Herts., which serve the northern part of Hatfield and neighbouring villages. The new works, designed for a flow of 1 m.g.d., include increased pumping capacity, additional percolating filters and 3 microstrainers for tertiary treatment of humus-tank effluent before discharge to the river Lee. Storm sewage is returned for full treatment after storage. After two-stage digestion, sludge is dried on beds.
W69-01550

WORTHING'S L500,000 SCHEME OF DRAINAGE IMPROVEMENTS.

Surveyor, London, Vol 121, pp 1069-1070, 1962.

Descriptors: Storm runoff.
Identifiers: *Storage tanks.

Improvements are being made at the overloaded sewage works of Worthing, Sussex, where previously sewage was discharged to sea after screening and chlorination. At the West Worthing works, which will treat a dry-weather flow of 1.31 m.g.d., the screens are being replaced by comminutors, and sedimentation tanks and new storm-water tanks are being constructed. At the East Worthing works (which will have a dry-weather flow of 3.14 m.g.d.) improvements include the enlargement of the existing pumping station, installation of a comminutor, conversion of the existing tidal storage tanks to storm-water tanks, and construction of new storage tanks. The effluents will be discharged over a tidal period of 8 1/2 hours. Sludge from both works will be combined with refuse and sold as compost.
W69-01551

CALCUTTA. 2. A SANITARY ENGINEERING APPROACH TO A MULTIPLICITY OF PROBLEMS,
P. C. Bose, and R. G. Ludwig.
Water Sewage Works, Vol 112, pp 164-167, 1965.

Descriptors: *Flood control, Drainage systems, *Design, Storms, Sewage treatment, *Storm runoff.
Identifiers: *Capacity, *Combined sewers, *Storm sewers, Calcutta (India).

To improve the sewerage system at Calcutta and alleviate flooding during the monsoon period it is proposed to increase the capacity of the existing combined sewers and drainage channels, provide connexions to the trunk sewers, and construct separate sewers for storm water and sewage in the unsewered districts, using 2-month storm frequency data as a design basis for the urban sections. Treatment works are planned for the districts of Tollygunge, Cossipore-Chitpore, Howrah, and Chandernagore.
W69-01562

UNIT HYDROGRAPH CHARACTERISTICS FOR SEWERED AREAS,
Peter S. Eagleson.
ASCE Proc, J of Hydr Div, Vol 88, No HY2, Part 1, March 1962.

Descriptors: *Hydrographs, *Overflow, Sewers, Storms, Drainage.
Identifiers: *Storm sewers.

Hydrographs of measured storm sewer outflow from urban areas up to 7.5 sq. miles in size are analyzed. The characteristics of the hydrographs are correlated with the properties of sewers and drainage basins in order to permit construction of synthetic unit hydrographs for other unmeasured sewered areas. Applicability of the derived relationships is tested against a measured outflow hydrograph for a complex storm.
W69-01566

LIMITING FACTORS IN RAINFALL RUN-OFF,
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01589

RAINFALLS OF SHORT DURATION AN HIGH INTENSITY: AN ALTERNATIVE TO BI HAM'S FORMULA,
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01590

WATER AND WASTE-WATER ENGINEERIN I. WATER SUPPLY AND WASTE-WATE REMOVAL,
G. M. Fair, J. C. Geyer, and D. A. Okun.
New York, Wiley, 1966. 1246 p.

Descriptors: Design, Sewers, *Rainfall-runoff re tionships, Surface runoff, Groundwater, Equi ment.
Identifiers: *Storage tanks.

This book is based on a previous publicati produced in 1954 and is designed to help studer of civil and sanitary engineering to understand t principles of water supply and waste dispos Chapters are included on water-supply a sewerage systems; information analysis; wa requirements and volumes of sewage; relatio between rainfall and runoff and the control a storage of runoff; flow and collection of grou water and surface water; transmission and distrib tion of water; collection of sewage; design a operation of machinery and equipment; optimi tion techniques; and carrying out of engineeri projects. Information and conversion factors given in an appendix, and a bibliography and s ject index are included.
W69-01591

5E. Ultimate Disposal of Wastes

KREMEYER V SHUMATE)DEBRIS-PLUGG DRAINS(.

20 111 App 2d 542, 156 N E 2d 271-274 (1959)

Descriptors: *Illinois, Judicial decisions, Del avalanches, *Garbage dumps, *Landfills, Gull Ravines, Ditches, Drains, *Damages, Fouli Flood damage, Floods water injury.

Defendants, operators of a scavenger busin deposited garbage, debris and junk on their prop ty. A portion of this debris was used to fill ditc and gullies in which a ravine terminated. A sev rain washed debris from the dumping place carried it down through the ravine onto plaint property, where the water-borne debris plugged the end of a drainage pipe running beneath pl tiffs' front yard. Plaintiffs' sued for damages to t property from flooding allegedly caused by plugging of the pipe. The court awarded plaint a reasonable amount to unplug the drain but de any recovery for permanent damage to the property, holding that plaintiffs had not satis their burden of establishing a causal connec between the negligent piling of the garbage and eventual damage to improvements on plaint land.
W69-01321

POWER OF MASSACHUSE METROPOLITAN DISTRICT COMMISSION
Mass Ann Laws ch 92, secs 75-79 (1967).

Descriptors: *Massachusetts, *Administrat *Water permits, *Eminent domain, Legisla Administrative agencies, Cities, Water pollut Pollution abatement, Construction, Water p tion sources, Sewage disposal, Industrial w Government finance, Water utilization, W levels, Water quality, Drainage, Sewers, Rese tion doctrine.
Identifiers: Harbor masters, Public hearings.

Section 75 empowers the Metropolitan Dis Commission to appoint a harbor master assistant harbor masters to exercise auth within the Charles river basin. Section authorizes the commission to order the remov

sewage and other polluting matter from the harles River. Section 76A gives the commission thority to issue permits for the taking of water om the Charles river basin for the purposes of fire otection and sale to manufacturing establishents. Specified conditions must be met before a rmit is issued. Section 76B specified conditions der which the permit is granted; violation of any ndition is ground for revocation. Sections 76C d 76D pertain to suitable connections for use of y water in case of revocation, and to mainnance of the water level in the river basin. Sec- n 76E permits cities to borrow money to finance nstruction of water works. Section 77 empowers e commission to take by eminent domain any nds for the purpose of sewage disposal. Section deals with eminent domain powers for construc- n, maintenance, and operation of a system of etropolitan water works. Section 79 deals with minent domain for reservations. (Smodish-Fla)
69-01328

N ACT PROHIBITING THE DISPOSAL OF ARBAGE AND REFUSE IN COASTAL OR IN- AND WATERS.

assachusetts Laws ch 116 (1967).

escriptors: *Massachusetts, Legislation, *Water llution control, Inland waterways, *Solid wastes, Domestic wastes, Water quality.

hapter 270, Sec 16 of the General Laws, relating the disposal of garbage and refuse, is expanded include coastal or inland waters, whether they e salt or fresh water, and areas within twenty rds of such waters. (R. F. Williams-Fla)
69-01331

N ACT SUBJECTING CERTAIN PERSONS HO DISCHARGE OIL AND PETROLEUM RODUCTS INTO CERTAIN INLAND WATERS ND INTO TIDAL WATERS TO TORT LIA- LITY IN DOUBLE DAMAGES.
assachusetts Laws ch 507 (1967).

escriptors: *Massachusetts, Legislation, amages, *Legal aspects, Water pollution, Oil, Oil wastes, Oily waters, Inland waterways, Tidal aters.
entifiers: Damages (Legal aspects).

ction 59A is inserted in Chapter 91 of the eneral Laws. It provides that anyone who gligently pumps or discharges oil or oil wastes to any lake, river tidal waters or flat so that the operty of another is damaged, shall be liable in rt for double damages to the owner of such maged property. (R. F. Williams-Fla)
69-01332

HIPPING, SEAMEN, AND PORTS: IN ENERAL.

Ga Code Ann Secs 101-105 (1967).

escriptors: *Georgia, Legislation, *Navigation, ips, *Local governments, Bays, Harbors.

wners of boats employed in navigation of the vigable waters of the state are required to furnish bill of lading to each boat before it leaves for its stination. Dumping of any ballast in a bay or har- r, or within three miles thereof is forbidden, and penalty is provided. Any pilot failing to inform e authorities of such an offense shall be deprived his license. Attachment may be used to collect e fine specified as the penalty for unlawful dump- g of ballast. The city councils of towns and cities e granted the authority to prohibit the throwing any substances into navigable waters within their spective jurisdictions. (R. F. Williams-Fla)
69-01333

EWAGE DISPOSAL,
J. A. Stow.
Surveyor Vol 106, p 567, 1947.

Descriptors: *Water pollution, *Standards, *Storm runoff, Sewage effluents.
Identifiers: *Great Britain.

The author discusses the existing state of river pollution in Great Britain with special reference to the need for standards for sewage works effluents, and for more complete treatment of all storm water.
W69-01531

5F. Water Treatment and Quality Alteration

MATHEMATICAL MODEL FOR DETERMINING THE OPTIMAL SIZES OF WATER TREATMENT PLANTS.
Harvard Univ., Cambridge, Mass., Harvard Water Resources Group.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01213

EUTROPHICATION AND WATER POLLUTION,
Federal Water Pollution Control Administration, Washington.
Edward J. Martin, and Leon W. Weinberger.
Publication Number 15, Great Lakes Res Div, Univ Mich, pp 451-469, 1966. 19 p, 4 fig, 8 tab, 45 ref.

Descriptors: *Eutrophication, *Nutrients, Pollutants, Pollution abatement, Nuisance algae, Phosphates, Nitrates, Rivers, Sewage treatment, Water pollution sources, Primary treatment, Secondary treatment, Tertiary treatment, Electrodialysis, Ion exchange, Activated sludge, Denitrification.

Authors define the mechanism of eutrophication and evaluate probable sources and nature of the pollutional loads responsible for accelerated eutrophication. This involves considerations of types and quantities of nutrient material, especially nitrogen and phosphorus, in terms of control and the frequency and intensity of algal blooms. On rivers, between 1961 and 1963, 49% of 130 stations reported algal counts which could be defined as blooms; 55% of 345 stations reported values of phosphate equaling or exceeding 0.2 mg/1. Wastes resulting from municipal, agricultural, and industrial uses of water contribute significant amounts of nutrients that may promote eutrophication in waterways. About 235 to 2,350 tons of phosphate are discharged daily to receiving waters from municipal waste sources in the US alone. Maximum efficiences of seven treatment processes for removing nitrogen and phosphorus are reviewed. 50% of total phosphorus and 80% of total nitrogen are removed by use of an activated-sludge process, while 99+% of the phosphorus and nitrogen are removed with a treatment sequence using ion exchange. These data indicate that treatment capabilities are available to control the discharge of nutrient compounds from point sources of wastes and to treat them to almost any desired degree.
W69-01453

5G. Water Quality Control

APPLICATION OF DECISION THEORY TO SANITARY ENGINEERING DESIGN PROBLEMS.
Harvard Univ., Cambridge, Mass., Harvard Water Resources Group.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01212

WATER QUALITY IMPROVEMENT PROGRAMMING PROBLEMS,
Stanford Univ., and Stanford Research Institute, Stanford, Calif.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01219

PLANNING RATIONAL WATER POLLUTION CONTROL POLICIES,
Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01223

A STUDY OF THE INTERACTIONS AND FOAM FRACTIONATION OF SEWAGE EFFLUENT--ACID MINE DRAINAGE MIXTURES,
Pennsylvania State University, University Park.
Robert C. Streeter, and Daniel C. McLean.
Water Resour Res Publ No 6-66, Pa State Univ, 1966. 51 p, 7 fig, 6 tab, 28 ref. OWRR Project A-004-Pa.

Descriptors: *Sewage, *Sewage treatment, Sewage effluents, Foams, Oxygen demand, Aeration, pH, Waste water, Waste disposal, Laboratory equipment, Oxygen requirements, Dissolved solids, *Surfactants, Acid mine water, *Mine drainage, *Foam fractionation.

This report encompasses removal of surfactants (derived from sewage effluent) and iron salts (derived from acid mine drainage waters) from contaminated Pennsylvania streams by foam fractionation techniques. Introduction of biodegradable surfactants to the market shortly after project initiation caused the foaming characteristics of treated domestic sewage effluents to be so poor as to obviate foam fractionation. However, a simple conbination of excess volume of sewage effluent with acid mine drainage (AMD) was found to result in significant water purification interactions. Sewage effluent-AMD mixtures were subjected to aeration, fluid-solid separation, and foam fractionation in a continuous process involving relatively short retention times and utilizing inexpensive equipment. Desirable results of this treatment are given. Precipitation of ferric hydroxide, which occurs when sewage effluent-AMD mixtures are neutralized, results in removal (by co-precipitation or absorption) of certain objectionable inorganic anions and refractory organic materials normally resistant to conventional sewage treatment. The average sewage treatment plant should be able to handle the quantities of AMD involved without loss of treatment capability or decrease in capacity, in fact, an increased capacity should be experienced.
W69-01227

HANDBOOK OF POLLUTION CONTROL COSTS IN MINE DRAINAGE MANAGEMENT.
Fed Water Pollut Contr Admin, Dec 1966. 54 p, 13 fig, 2 tab, 49 ref.

Descriptors: Mine water, Economics, Costs, *Mine drainage, *Mine wastes, Strip mines, Grouting, Strip mine wastes, Coal mines, Coal mine wastes, Acid mine water, *Pollution abatement, Waste disposal.
Identifiers: *Monongahela River Basin, Monongahela River (Pa).

The information presented in this publication answers a need of the Monongahela River Mine Drainage Remedial Project for preliminary cost data in determining relative costs of mine drainage abatement. Costs of remedial measures are listed and evaluated on a unit price basis. They cover a period of 33 years from 1933 to the present time. These include unit costs on such items as mine seals or bulkheads; surface reclamation of strip-mines along with associated planting; reclamation of refuse areas; drainage diversion and impoundment; and treatment of mine drainage. Methods examined are grouped into those dealing with underground mine drainage, surface mine drainage, drainage from refuse and waste disposal areas, and control and treatment of water in active mining situations.
W69-01236

WATER TRANSLOCATION OF DIAZINON-CARBON 14 AND PARATHION-SULFUR 35 OFF A MODEL CRANBERRY BOG AND SUBSEQUENT OCCURRENCE IN FISH AND MUSSELS,
Massachusetts University, Cranberry Experiment Station, East Wareham.
C. W. Miller, B. M. Zuckerman, and A. J. Charig.

Rep Trans Amer Fisheries Soc, Vol 95, No 4, pp 345-349, Oct 1966. 5 p, 2 tab, 9 ref, disc. OWRR Project A-010-Mass.

Descriptors: *Pesticides, Fish physiology, Pesticide toxicity, Fish, *Diazinon, Translocation, Runoff, Metabolism, *Pesticide residues, Mussels, *Cranberries, Bogs.

Transportation of diazinon-carbon 14 and parathion-sulfur 35 off a model cranberry bog following a simulated rost protection flood was shown 24 hr after application of the chemicals. Fish and fresh water mussels were exposed to these contaminated waters and analyzed periodically. The majority of the chemicals disappeared from the water after 144 hr. During this time, no labeled metabolites of diazinon were detected; however, three labeled parathion degradation products were encountered. Accumulation of both pesticides occurred in the fish and mussels, often to levels far in excess of that present in the waters. The fish appear able to metabolize these accumulated chemicals at a faster rate than the mussels.
W69-01243

THE EFFECTS OF WEIRS ON THE AERATION OF FLOWING STREAMS,
Rhode Island University, Kingston.
Warren M. Hagist.
Water Resour Center Completion Rep, Univ R I, June 1967. 8 p. OWRR Project A-007-RI.

Descriptors: *Aeration, *Weirs, Channel flow, Oxygen, Waste water treatment, Laboratory tests.

The purpose of the research was to perform a systematic investigation of the effect of weirs on the aeration of flowing streams. The experiments were performed in a rectangular laboratory channel using (1) a single suppressed weir with and without a downstream step of variable height and width, (2) two suppressed weirs in tandem, (3) a single contracted weir with and without a downstream step of variable height and width. The upstream and downstream oxygen concentrations were measured with a continuous reading oxygen analyzer. For the weirs without steps maximum oxygen pick-up occurred when the depth of the downstream water was about 1/3 the weir height. The presence of the downstream step doubled the aeration efficiency. The width of the step made almost no difference, but a step height of between 3/4 and 5/6 the weir height produced maximum aeration. Aeration efficiency of weirs is low, but their low installation and operating costs are attractive. (Author)
W69-01257

WATER POLLUTION - ECONOMIC ASPECTS AND RESEARCH NEEDS,
Allen V. Kneese.
Washington, D. C. Resources for the Future, 1962. 107 p, 104 ref, 2 append.

Descriptors: Impaired water quality, Pollutant identification, Public health, *Water pollution, *Water pollution effects, Water pollution sources, Pollution abatement, *Water pollution treatment, Water quality control, Social aspects, Economic efficiency, Economic impact, River basin development, *Model studies, Analytical techniques, Optimization, Optimum development plans, Operations research, Water pollution control, Sewage treatment.

The economic consequences of water pollution are discussed thoroughly. An economic framework is established to determine research needs. The nature, effects, treatment and alternatives to treatment of water pollution are delineated. Economic efficiency and social policy are discussed in relation to the pollution problem, and individual values and social values are evaluated. It is concluded that the results of unregulated wastes disposal into bodies of water fail to coincide with the attributes of an ideally functioning market system. It is suggested that a broad goal of public policy should be to minimize the social costs associated with wastes disposal. Research needs are discussed primarily in light of the complex problems involved. Computational and scientific problems, deficiencies in technical and economic knowledge, and problems in devising procedures for approximating optimum systems are examined. Several lines of investigation are suggested, and areas in which critical improvements in knowledge are needed are identified. (Pfeiffer-Fla)
W69-01269

ECONOMIC EFFICIENCY, SOCIAL POLICY, AND THE POLLUTION PROBLEM.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01271

DIVISION OF WATER POLLUTION CONTROL.
State of Massachusetts, Boston.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01296

GEORGIA WATER QUALITY CONTROL ACT.
State of Georgia, Atlanta.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01300

AN ACT CREATING A POLLUTION CONTROL AGENCY AND CREATING AN OFFICE OF DIRECTOR THEREOF: PROSCRIBING THEIR POWERS AND DUTIES: EMPOWERING THE GOVERNOR TO ACT IN AN EMERGENCY.
State of Minnesota, St. Paul.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01304

AN ACT TO AMEND SECTION 16 OF 'AN ACT TO ESTABLISH A SANITARY WATER BOARD AND TO CONTROL...POLLUTION...'

Illinois Laws ch H 1177 (1967).

Descriptors: *Illinois, *Legislation, *Water pollution control, Cities, *Administrative agencies.
Identifiers: Federal Water Pollution Control Act, Sanitary districts.

An act establishing the Sanitary Water Board in Illinois is herein amended. The effect of the amendment is to allow the board to set and enforce water quality standards for existing sanitary districts with populations of 1,000,000 or more; specifically, the Metropolitan Sanitary District of Chicago. This statewide control by the board is required for Illinois to receive benefits under the Federal Water Pollution Control Act. (Sisserson-Fla)
W69-01314

AN ACT...RELATING TO WATER RESOURCES, THE WATER POLLUTION CONTROL ACT, AND...DUTIES...OF THE DIVISION OF WATER RESOURCES AND THE WATER RESOURCES BOARD.

Laws of West Virginia 1967 ch 143.

Descriptors: Legislation, Water law, Water control, Public health, Administrative agencies, *West Virginia, State governments, Water policy, Water resources development, Water flow, Permits, *Environmental sanitation, Water purification, Water pollution, Water resources, *Pollution abatement, Water pollution treatment, Industrial wastes, *Water pollution control, Sewage treatment, Sewage disposal.

This act amends the code of West Virginia pertaining to water pollution control. The act provides a general declaration of policy reflecting primary concern for the protection of public health and preservation of natural water resources. In addition, it encompasses definitions of terms used; the general powers and duties of the chief of the division of water resources and the water resources board with respect to water pollution; requirements for permits for specified activities; applications for and forms of permits; permit fees; procedures concerning permits; the transfer of permits; orders of the chief to stop or prevent discharges or deposits orders of the chief to take remedial action; service of orders; duty to proceed with remedial action upon receipt of permit; progress reports; finances and funds; appeals to and review procedures before the water resources board; circuit courts and the supreme court of appeals; actions to abate nuisances; injunctive relief; violations; and criminal penalities. (Kuder-Fla)
W69-01317

AN ACT...RELATING TO THE APPOINTMENT OF VOLUNTARY WATER QUALITY MONITORS.
West Virginia Laws ch S 334 (1967).

Descriptors: *West Virginia, Legislation, Administrative agencies, *Water quality control, *Water pollution control, Legal aspects, Monitoring, Oversight data collections, *Sampling, Water analysis, Pollutant identification.

Section 8A was added to Article 5A, Chapter 20 of the Code of West Virginia (1931). Article 5A was entitled the 'Water Pollution Control Act.' The new section authorizes the appointment of volunteer water quality monitors. These monitors are to take samples of the waters of the state and forward them to the state water resources chief for analysis. The monitors are to be provided with training and equipment to perform these duties. They are to be paid fifty cents for each sample. These samples are admissable in all state courts for the purpose of enforcing the pollution laws. (Sisserson-Fla)
W69-01318

CITY OF UTICA V WATER POLLUTION CONTROL BD)AUTHORITY OF WATER POLLUTION CONTROL BOARD(.
5 NY 2d 164, 156 NE 2d 301-306 (1959).

Descriptors: *New York, Judicial decisions, Administrative decisions, Local governments, State governments, Water pollution, *Pollution abatement, *Public health, Abatement, Classification, Standards.

The state legislature passed a water pollution control law that directed the defendant water pollution control board to employ experts to classify waters of the state. When making these classifications the defendant was to consider many specifically enumerated factors. Acting under the authority of the statute, defendant adopted classifications and standards of quality and purity, and assigned the same to waters within the plaintiff's area. Defendant then submitted to plaintiff a pollution abatement plan. Plaintiff did nothing to abate the pollution for two years, at which time defendant charged plaintiff with violating sections of the public health law. Plaintiff then brought this action to restrain defendant from acting on the ground that the water pollution law was unconstitutional. The court held that the act was a valid delegation of authority by the legislature, and that it provided adequate standards for the board's guidance. The legislature cannot confer discretion upon an agency if, as was done here, it had stated an intelligible principle or specified the standards and guides in as detailed fashion as is reasonably practicable in the light

ne complexities of the particular area to be regu-ated. The court affirmed the dismissal of plaintiff's ction. (S. Scott-Fla)
V69-01322

OWN OF WATERFORD V WATER POLLU-ION CONTROL BD)FINANCIAL CON-IDERATIONS AND WATER CLASSIFICA-ION(.
NY 2d 171, 156 NE 2d 427-443 (1959).

escriptors: *New York, Judicial decisions, Ad-inistrative decisions, Local governments, State overnments, Water pollution, Pollution abate-ent, Public health, Abatement, *Classification, tandards, *Financial feasibility, *Economic feasi-ility, Financing, Costs, Project planning.

laintiff instituted this proceeding to challenge the ght of defendant to assign a certain classification certain waters in its area on the ground that the efendant failed to give any consideration to the scal and economic aspects of its classification. he court held that under the act creating the oard, the defendant was not required to consider robable costs, relative priorities, or problems of unicipal financing when adopting a classification f particular waters. Financial disability might im-ede the construction of the facilities needed to omply with the adopted classifications; however, ne proper relief is not the annulment of the as-gned classification, but rather an extension of me in which to effect the needed improvements. he court affirmed the defendant's assigned clas-fication, holding that the raising of financial con-derations was premature. (S. Scott-Fla)
V69-01323

IETHODS FOR HARVESTING OR CONTROL F AQUATIC PLANTS,
Visconsin Univ, Madison, Water Resources enter.
ere Neil Mossier.

escriptors: *Eutrophication, *Harvesting, Aquatic weed control, *Lakes, Ecology, Primary roduction, Aquatic habitats, Sediment control, Vater quality control, Vegetation, Watershed anagement, Plant growth, Vegetation regrowth, cuba diving, Wisconsin.
dentifiers: Lake Mendota, Ceratophyllum, Myriophyllum, Vallisneria.

nalysis of three 800-sq-m submerged stands in ake Mendota, Madison, Wis, demonstrated har-esting submergent macrophytes to be a feasible ontrol procedure. Two stands with Myriophyllum albescens dominant and Ceratophyllum demer-um subdominant were subjected to variable har-est treatments from June through August. Myriophyllum at water depths of 1.4-2.1 m was ontrolled by one harvest; mid-July harvest ap-eared most effective. Myriophyllum at 1.0-m epth required two harvests; June-August com-ination appeared best. With decreasing depth, ate of macrophytic growth increases, making more requent cutting necessary. Vallisneria americana t 1.0-1.6 m required only one harvest regardless of epth. Two transects were harvested mechanically. Growth responses of Myriophyllum and Ceratophyllum in these corresponded to responses f plants cut with hand sickles using SCUBA. An conomical system to utilize the harvested crop is eeded. New uses for Myriophyllum as animal feed r fertilizer may encourage investments in echanical harvesting. Complete removal of plants rom University Bay is not a sound ecological ven-ure. Macrophytes reduce the distance silt and uspended matter are carried into the lake system nd provide for biotic needs. The possibility of verharvesting is real; change in species composi-on with change in the environment is inevitable. Harvesting measures must be ecologically sound.
V69-01399

WATER QUALITY AND RESOURCES ALLOCATION BY PRIVATE MARKETS,
Resources for the Future, Inc.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01401

STANDARDS, CHARGES, AND EQUITY,
Resources for the Future, Inc.
Allen V. Kneese, and Blair T. Bower.
Managing Water Quality: Economics, Technology, Institutions, Baltimore: Johns Hopkins Press, 1968, Chap. 7, p 131-142, 3 fig, 3 ref.

Descriptors: *Water quality control, *Economic efficiency, Administrative costs, Comparative costs, Economic evaluation, Competing uses, Optimum development plans, Economic justification, *Marginal costs, Market value, Payment, Water costs, Variable costs, Institutional constraints.
Identifiers: Effluent charges, Equity.

Possible standards for water quality in streams, lakes, and estuaries are discussed. 'Complementarities' in treatment or other measures for reduction of waste discharges are reviewed with consideration of effluent standards. The effluent charge can be used to achieve stream water quality standards efficiently, i.e. at lowest economic or resource cost. Each waste discharger is charged in proportion to the use he makes of a resource - the waste assimilative and transport capacity of the watercourse. The waste discharger can compare his marginal costs and marginal charges and decide whether it pays him to reduce his waste and to what degree. The revenue that accrues to the agency from the charges can be viewed as a rental return on a natural resource. Ideally, charges should be levied on all activities which reduce water quality sufficiently to impose external costs, but this may not be administratively feasible. A discussion of the equity of charges which focuses on the distribution of costs of water quality management is presented. (Gargola-Chicago)
W69-01402

REPORT ON MULTILEVEL OUTLET WORKS AT FOUR EXISTING RESERVOIRS,
Bureau of Reclamation, Denver, Colo., and Sacramento, Calif.
Garry H. Austin, Donald A. Gray, and Donald G. Swain.
Pap Selec Withdrawal Reservoirs ASCE Hydraul Div conf, Cambridge, Mass, Aug 1968. 38 p, 12 fig.

Descriptors: *Outlet works, *Outlets, *Water quality, Multiple purpose reservoirs, Intake gates, Intake towers, Intake structures, Discharges, Fish and wildlife, Reservoir operation, Hydraulic structures, Hydraulic gates and valves, Fish.
Identifiers: *Multilevel outlets, Water temperature, Water use, *Water quality control, Salmon, California, Selective level releases.

Design and performance of 4 multilevel outlet works constructed by the Bureau of Reclamation are discussed. The need for water quality control by selective reservoir releases has increased as more multipurpose reservoir applications have combined such diverse uses as irrigation, power generation, flood control, municipal and industrial water supply, fish and wildlife, recreation, and navigation. The 4 reservoirs (Cachuma, Casitas, Folsom, and Whiskeytown) have been in operation from 6 to 13 yr and present some variation in water quality situations and outlet designs. Cachuma and Casitas Reservoirs are thermally stratified during summer. Taste and odor requirements have governed the withdrawal level selection, but chlorine demand, temperature, and dissolved oxygen are considered. Modifications were made at Folsom Dam after completion to allow withdrawal of reservoir water from upper and lower levels. Salmon spawning requirements downstream from Folsom fix the maximum water temperature at 58 deg F. Selective withdrawal provisions at Whiskeytown Dam were planned for temperature control of releases to Clear Creek, a salmon spawning stream. (USBR)
W69-01437

RECLAIMED WATER WILL HELP FILL LAKES.

Publ Wks, N Y, Vol 96, No 3, pp 82-83, 1965.

Descriptors: *Storm runoff, Drainage, Tunnels, Design flow, *Water reuse.
Identifiers: Combined sewers, Minneapolis, Minn.

Details are given of a proposal to use storm water and water discharged from air-conditioning plants to maintain the levels in a chain of recreational lakes at Minneapolis, Minn., during the summer months. By constructing a control dam in the lower portion of the existing system of drainage tunnels, 2.6 mil. gal of water can be impounded. The dam will be fitted with a sluice gate which will permit periodic flushing of the system, and will open automatically during heavy rainfall. The air-conditioning water is of good quality, and precautions will be taken to avoid interconnexions between the tunnels and the city's combined sewerage system. It is estimated that, in spite of variations in flow, the design flow of 22 ft (3) per sec can be maintained during most of the 100-day period when it is intended to divert water to the lakes.
W69-01502

REPORTS ON THE PROGRESS OF APPLIED CHEMISTRY.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01505

WATER POLLUTION RESEARCH, 1965.
Great Britain Ministry of Technology.

London, H M Stationery Office, 1966. 224 p, 4 plates.

Descriptors: *Storm runoff, Sewage treatment.
Identifiers: Great Britain.

This report contains information on work carried out at the Water Pollution Research Laboratory during 1965, including investigations on the activated-sludge process and biological filtration; biological decomposition of synthetic detergents; role of protozoa in biological treatment processes; ecology of invertebrates in filters; sedimentation of sewage and humus; factors affecting digestion and dewatering of sludge; volume and composition of storm sewage; treatment of humus-tank effluent in pebble-bed clarifiers; recovery of water from sewage effluents; treatment and disposal of various types of trade waste water; effects of pollution on fish; oxygen balance in streams; control of water weeds and midges; growth of sewage fungus in streams; dispersion of sewage from sea outfalls; and development of analytical methods and instruments. A list of papers published during the year is appended.
W69-01506

WATER POLLUTION RESEARCH, 1964.
Great Britain Ministry of Technology.

London, H M Stationery Office, 1965. 182 p.

Descriptors: Sedimentation, *Storm runoff, *Biochemical oxygen demand, *Chemical analysis, Flow measurement.
Identifiers: *Suspended solids, *Great Britain.

This report contains the results of investigations on the following subjects: (1) aerobic biological treatment of sewage and industrial wastes; (2) sedimentation processes; (3) sludge treatment; and (4) sewage. The data obtained on the flow and composition of storm sewage at Brighouse, Yorkshire have been analyzed. Although the B.O.D. and con-

centration of ammoniacal nitrogen in storm sewage were lower than the dry-weather values, the concentration of suspended solids was always much higher. In general, the B.O.D., permanganate value, and ammonia content of the storm sewage discharged in the first 15 minutes were about twice as great as that discharged after the first 30-40 minutes; the reduction in suspended solids content was much less marked.
W69-01507

TECHNICAL PROBLEMS OF RIVER AUTHORITIES AND SEWAGE DISPOSAL AUTHORITIES IN LAYING DOWN AND COMPLYING WITH LIMITS OF QUALITY FOR EFFLUENTS MORE RESTRICTIVE THAN THOSE OF THE ROYAL COMMISSION.

Ministry of Housing and Local Government, London, 1966, 20 pp.

Descriptors: *Sewage effluents, *Standards, Dissolved oxygen, *Storm runoff, Sampling.
Identifiers: *Suspended solids, *Great Britain.

This memorandum explains the circumstances under which sewage effluents should be required to reach a standard better than that recommended by the Royal Commission. In deciding the standards to be imposed under particular circumstances, consideration should be given to the probable concentration of dissolved oxygen in the effluent and the possible need for aeration; seasonal variations in requirements; and flows to be treated, including the proportion of storm sewage to be expected. The only standard considered justifiable for discharges of storm sewage is a condition limiting the content of suspended solids, and since this concentration is highly variable it is recommended that these effluents should not be required to conform to a given standard (e.g. 100 mg per liter) all the time, but provision should be made for one or two samples out of every ten, taken on different days, to exceed the limit.
W69-01517

TRENDS IN FINANCIAL SUPPORT FOR WATER POLLUTION CONTROL,
North Carolina Univ., Raleigh, N. C. Water Resources Res. Inst.
David H. Howells.
ASCE Proc, J Sanit Eng Div, Vol 93, No SA3, pp 1-13, June 1967.

Descriptors: *Water pollution control, Construction, *Grants, *Legislation.
Identifiers: *Combined sewers.

The trend in Federal support of municipal waste-treatment construction is toward larger annual appropriations with higher levels of support for states providing matching funds. States should enact parallel grant-in-aid legislation to take full advantage of Federal aid in the future and maintain an influential position in water-pollution control. Rapid movement toward financial assistance for industrial waste treatment is not anticipated unless the current study by the Secretary of the Interior should add to the momentum. Effluent charges are considered unlikely if industry responds favorably to its responsibilities for water-pollution control. The Clean Waters Restoration Act of 1966 authorized 75% grants to public bodies for projects concerned with improved pollution control from combined sewers.
W69-01526

INTERPRETING THE 1951 RIVERS POLLUTION PREVENTION ACT,
W. F. Lester.
Munic Eng Sanit Rec, Vol 131, pp 186-7, 1954.

Descriptors: Standards, Sewage effluents, *Water pollution, *Overflow, *Storm runoff, *Legislation.
Identifiers: *Rivers (Prevention of Pollution) Act 1951.

The author discusses the implementation of the Rivers (Prevention of Pollution) Act 1951. Details are given of the standards recommended by the Royal Comm. on Sewage Disposal for effluents discharged to surface waters and demands are made for more stringent standards. The problem of dealing with storm water overflows from sewage works or from separate sewerage systems is duscussed with reference to the work of the River Boards in making by-laws.
W69-01527

WATER POLLUTION CONTROL FEDERAL AID PROGRAMS,
Paul W. Reed.
12th Annual Wastes Engng Conf, U of Minn, Minneapolis, Minn, Dec 10, 1965, 15 p.

Descriptors: *Water pollution control, *Construction, *Grants, *Legislation.

The FWPCA is described with special emphasis on the construction grant programs. Surveys of municipal waste treatment needs are described. The Water Quality Act of 1965 is outlined. Public Health Service studies on water pollution control are summarized as well as related Federal programs.
W69-01529

THE CONSTRUCTION OF RETARDING BASINS FOR THE DRAINAGE OF MOTORWAYS,
G. W. Annen.
Gas-u WassFach, Vol 108, pp 46-48, 1967.

Descriptors: Runoff, *Drainage, *Highways, Pollution abatement.
Identifiers: Retarding basins.

A detailed description is given of the design and operation of retarding basins, which have been installed along the newly-built motorway south of Dortmund, Germany. These basins are designed to slow down the run-off, separating mechanically the insoluble polluting substances, particularly oils, and thus protecting the receiving waters.
W69-01532

SANITARY SERVICES. GREAT ACHIEVEMENTS FOR A PLAN OF WORKS.

Rev Obr sanit Nac, B Aires, Vol 42, pp 164-185, 1960.

Descriptors: *Planning, *Sewers.
Identifiers: Storm sewers, *Argentina.

After a review of legislation relating to the provision of water supplies and storm and sanitary sewerage systems in Argentina, brief descriptions are given of the facilities in operation, under construction, and planned, for more than a hundred different urban centers, each considered individually. A map is included showing the position of water supply and sewerage systems throughout the country.
W69-01558

EFFECTS OF LAND USE ON WATER RESOURCES,
W. E. Bullard.
J Water Poll Control Fed, Vol 38, pp 645-59, April 1966.

Descriptors: *Land use, *Water quality, Sedimentation, Nutrients, *Water pollution, Runoff.
Identifiers: *Urban drainage.

Land use, among other factors, determines the quality of water produced. Erosion causes turbidity and sedimentation, lowers water quality, and damages aquatic life habitats. Fertilizers, pesticides, and other toxins and nutrients contribute to pollution. Agriculture, timber, mining, urban runoff, and recreation also are pollution contributors.
W69-01564

ECONOMIC SURFACE-WATER SEWERAGE: A SUGGESTED STANDARD OF PRACTICE,
L. B. Escritt, and A. J. M. Young.
J Instn Publ Hlth Engrs, Vol 62, 1963.

Descriptors: *Design, *Sewers, *Storm runoff, Storms, Surface runoff.
Identifiers: *Surface permeability, *Urban drainage.

In an examination of data, provided by the Road Research Laboratory, for use in the design of sewers, the authors question the conclusion that the amount by which calculated rates of runoff during storms exceed recorded rates is due to storage. They suggest that it is due to a change in impermeability of the catchment and describe an experiment, using a sheet of plate glass as a catchment, to support their views. The Lloyd-Davies method of calculation should be used, with the assumption that roofed and paved surfaces in developed areas have an impermeability of 80 per cent and not 100 per cent as the Road Research Laboratory suggests.
W69-01569

06. WATER RESOURCES PLANNING

6A. Techniques OF Planning

DISCUSSION OF AQUEDUCT CAPACITY UNDER AN OPTIMUM BENEFIT POLICY,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01206

ECONOMIC CONTROL OF GROUNDWATER RESERVES,
Missouri Univ., Columbia.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-01207

PRODUCT-MIX ALTERNATIVES: FLOOD CONTROL, ELECTRIC POWER, AND IRRIGATION,
Stanford Univ., Palo Alto, Calif.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01208

THE USE OF STORAGE WATER IN HYDROELECTRIC SYSTEM,
Massachusetts Institute of Technology, Cambridge
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01209

STATISTICAL ANALYSIS OF THE RESERVOIR STORAGE - YIELD RELATION.
Harvard Univ., Cambridge, Mass., Harvard Water Resources Group.

In Operations Research in Water Quality Management, pp 1-1 to 1-21, Feb 15, 1963. 5 fig, 3 tab, ref.

Descriptors: Computer models, Correlation analysis, Distribution patterns, Evaluation, Hydrologic data, *Reservoir design, Reservoir operation, *Statistical methods, Regression analysis, *Synthetic hydrology, Water management (Applied), Water quality control.
Identifiers: *Storage-yield relation, Serial correlation.

A discussion of the development of synthetic hydrology was presented. The objective was the efficient application of statistical techniques to available hydrologic data for reservoir planning and operation. Results of a computer study indic

ing the level of reliability of storage estimates based on masstdiagram calculations were given. A variety of statistical populations of streamflow were investigated together with a range of annual drafts. The reliability of conventional storage estimates made from streamflow records of the usual length was shown to be low. The storage required to meet any given yield was then treated as a statistical variate whose distribution has the same first three moments as the observed streamflows. Given the distribution, or its moments, the specification of storage was treated as a problem in decision making under risk. The statistical technique was found to be superior to the conventional method. One of seven chapters in 'Operations Research in Water Quality Management'. (Gysi-Cornell)
W69-01210

A METHOD OF OPTIMIZING DESIGN OF WATER QUALITY MANAGEMENT SYSTEMS.
Harvard Univ., Cambridge, Mass., Harvard Water Resources Group.

In Operations Research in Water Quality Management, pp 6-1 to 6-14, Feb 15, 1963. 22 p, 7 fig, 3 ref.

Descriptors: Operations research, Computer programs, Comparative benefits, *Analytical techniques, *Design, Optimization, *Simulation analysis, Water quality, *Water management (Applied).
Identifiers: *Method of steepest ascent, Local optimum, Response surface.

The 'method of steepest ascent' was presented as a technique for finding the optimal design of a water management system, and was applied to an illustrative problem of a settling tank design. The technique was developed and adapted to machine computation. The computer evaluated the system at a starting point chosen by a random sampling technique, corresponding to a particular set of assigned values of the decision variables (design dimensions). It determined the gain in economic efficiency resulting from a small increment applied to each variable, and computed the combination of increments that caused the most rapid increase in net benefits. The subroutine which checked the continual progress of the decision variables toward their local optimum values was shown in a flow diagram. A comparison of a hand computation and a machine computation of the problem were given. One of seven chapters in 'Operations Research in Water Quality Management'. (Gysi-Cornell)
W69-01211

APPLICATION OF DECISION THEORY TO SANITARY ENGINEERING DESIGN PROBLEMS.
Harvard Univ., Cambridge, Mass., Harvard Water Resources Group.

In Operations Research in Water Quality Management, pp 4-1 to 4-16, Feb 15, 1963. 24 p, 8 fig, 13 ref.

Descriptors: Operations research, Computer programs, *Decision making, Distribution patterns, Discount rate, Economic efficiency, Mathematical models, Data collections, Estimating equations, Probability, Septic tanks, *Statistical methods, *Sanitary engineering, *Design, Water quality control, Risks.
Identifiers: *Statistical decision theory, Adsorption fields, Economic horizon.

A mathematical model employing statistical decision theory was developed to aid in the planning of complex systems. The model used matrix algebra and response surface sampling, and featured a method for reaching decisions under risk. It was applied to the problem of sewage disposal in unsewered subdivisions. The objectives were: (1) to develop a formulation and computational routine for determining the optimal balance of septic tanks and absorption fields at each site; (2) to develop criteria for indicating the proper number and kind of tests in each subdivision, and the proper interpretation of the tests regarding adsorption field capacities; and (3) to indicate if additional data on soil characteristics was needed or economically justified. The model evaluated the costs of making incorrect decisions and of having only uncertain information. The model considered economic parameters such as discount rates and time horizons, and included financing and administrative costs. One of seven chapters in 'Operations Research in Water Quality Management'. (Gysi-Cornell)
W69-01212

MATHEMATICAL MODEL FOR DETERMINING THE OPTIMAL SIZES OF WATER TREATMENT PLANTS.
Harvard Univ., Cambridge, Mass., Harvard Water Resources Group.

In Oper Res in Water Quality Management, pp 5-1 to 5-21, Feb 15, 1963. 28 p, 9 fig, 8 tab, 10 ref.

Descriptors: Operations research, *Decision making, Discount rate, Hydraulic design, Future planning (Projected), *Municipal water, *Mathematical models, *Optimal development plans, Project life, *Statistical methods, Water demand, Water treatment, Economies of scale.
Identifiers: *Decision theory, Present value, Loss function.

A decision theory model was presented which indicated the proper size of a water treatment plant to be developed. The problem required the balancing of economies of scale in present construction against the diseconomy of unprofitable investment in excess capacity not needed for several years. The plant size that maximized economic efficiency was expressed as a function of population growth rate, per capita demand for water, the interest rate of capital investment, and the economic time horizon. Municipal water requirements were not treated as rigid constraints. Instead, a loss function which assigned economic penalties to small or medium sized water shortages was used. A hypothetical example illustrated the use of the model. One of seven chapters in 'Operations Research in Water Quality Management'. (Gysi-Cornell)
W69-01213

OPTIMAL TIMING OF IRRIGATION,
California Univ., Riverside; Nevada Univ., Reno.
Warren A. Hall, and William S. Butcher.
Amer Soc Civil Eng Proc, Vol 94, No IR2, pp 267-275, June 1968. 3 ref, 2 append.

Descriptors: Estimated benefits, Estimated costs, Economic efficiency, Irrigation, *Irrigation efficiency, Irrigation programs, *Dynamic programming, Digital computers, Optimization, Seasonal, *Water management (Applied), Water distribution (Applied), Wilting point, *Water shortage, *Crop production.

A dynamic programming model was presented which determined the time and quantity of irrigation which maximized the total net returns from a crop. The state variables for the model were the soil moisture content and quantity of water available in each of the subdivided time periods considered for the growing season. The decision variable was the quantity of water used in each period. It was assumed that a coefficient which is a function of the soil moisture could be found that would give the percent of maximum yield of the crop for each period. The objective was to maximize the product of these coefficients times the maximum yield. Constraints for the model were physical (e.g., (1) amount of water available at the beginning of the season, (2) wilting point and field capacity for the soil moisture). An inventory constraint provided continuity between periods for the soil moisture. It was concluded that the methodology described could permit good irrigation management, provided more information became available on the critical period characteristics of commercial crops. (Gysi-Cornell)
W69-01214

A SOCIALLY OPTIMUM PRICING POLICY FOR A PUBLIC WATER AGENCY,
Washington Univ., Seattle; California Univ., Berkeley.
Gardiner Brown, Jr., and C. B. McGuire.
Water Resources Res, Vol 3, No 1, pp 33-43, 1st Quart 1967. 5 tab, 12 ref.

Descriptors: *Linear programming, Aquifers, Computer models, *Conjunctive use, Discount rate, Water allocation (Policy), *Water distribution (Applied), Water demand, Fixed costs, Variable costs, *Economic efficiency, Estimated benefits, Marginal costs, Public benefits, Social values.
Identifiers: Kern County Water Agency (Calif), Demand function, Pumping tax, Lagrange multiplier.

A model was developed for determining the socially optimum price to charge irrigation districts for both surface and groundwater supplies. An algorithm was developed assuming linear demand functions, and steady-state conditions for groundwater levels and water demand functions. A divergence between social and private optimums arose from the existence of unadjudicated rights to groundwater supplies. The social optimum was achieved by a taxing policy which equated the farmers' marginal private costs to the true marginal social cost. Hence, the farmers' profit maximization motivation yielded the desired social optimum. An example of the model was given for the Kern County Water Agency (California). Water prices, tax rates, and optimum lift levels were estimated for seven irrigation districts within the jurisdiction of the agency. (Gysi-Cornell)
W69-01215

OPTIMAL RESOURCE USE OVER TIME WITH AN APPLICATION TO GROUND WATER,
California Univ., Davis, California.
Oscar R. Burt.
Manage Sci, Vol 11A, pp 80-93, Sept 1964. 10 ref, 2 append.

Descriptors: *Dynamic programming, Aquifers, *Economic efficiency, Pumping, *Groundwater mining, Marginal productivity, Marginal costs, Synthetic hydrology, Water balance, Water allocation (Policy), *Water management, Optimum development plans, Consumptive use.
Identifiers: Kings River (Calif).

The problem of optimally allocating over time a fixed or only partially renewable resource was solved using dynamic programming. First and second degree approximations to the functional equation were used to solve the problem. Differentiation of the functional equation with respect to the resource level and its periodic use in order to maximize the expected net output yielded approximate decision rules for resource use. These decision rules were a function of current supply and interest rate. The results were applied to ground water storage control and tested empirically, using data from a study on the Kings River area in California. The results compared favorably with a decision rule obtained by detailed numerical methods. Additions to the resource were treated as random variables with probability distributions reflecting the type of resource and its method of recovery. The decision rules in general specified, as expected, that production should be expanded until marginal net output equals marginal recovery costs. (Gysi-Cornell)
W69-01216

THE OPTIMUM ALLOCATION OF STREAM DISSOLVED OXYGEN,
Johns Hopkins Univ., Baltimore, Md.; Cornell Univ., Ithaca, N. Y.
Jon C. Liebman, and Walter R. Lynn.

Water Resources Res, Vol 2, No 3, pp 581-591, 3rd Quart 1966. 11 p, 5 fig, 5 tab, 11 ref.

Descriptors: Biochemical oxygen demand, Design criteria, Digital computers, *Dissolved oxygen, *Dynamic programming, Economic efficiency, Sewage effluents, Oxygen sag, *Sewage treatment, *Standards, Waste assimilative capacity, *Stream improvement, Water policy, Water quality control.
Identifiers: Willamette River (Oregon), Uniform treatment.

A discrete dynamic programming model was used to minimize the cost of providing waste treatment to meet specified dissolved oxygen concentration standards in a stream. The model was developed from the Streeter-Phelps equation which relates dissolved oxygen to waste loading. It was assumed that the saturation level varied linearly within a reach. Choosing discrete values for water quality at the top of the reach, the costs of obtaining various levels of dissolved oxygen in successive downstream sections were computed by the recursive calculations of dynamic programming. A simplified example of the model based on data from the Willamette River in Oregon was solved and the results presented in tabular form. Three runs were made, one which met required stream standards, a second with the standards lowered by 0.1 mg/1 in all sections, and a third in which all plants treated at the same rate. The total cost of equal treatment was substantially more than the minimum cost of meeting the stream standards. (Gysi-Cornell)
W69-01217

FORMAL MODELS IN THE DESIGN OF WATER RESOURCE SYSTEMS,
Harvard Univ., Cambridge, Mass.
Robert Dorfman.
Water Resources Res, Vol 1, No 3, pp 329-336, July-Sept 1965. 5 ref.

Descriptors: *Analytical techniques, *Digital computers, Design, Economic efficiency, Environmental engineering, Linear programming, *Mathematical models, Monte Carlo Method, Queuing theory, Water resources development, *Simulation analysis, Systems analysis, *Water resources.

The use of simulation and analytic models in the design of water resource systems was discussed. A brief history of the evolution of these methods beginning with The Harvard Water Resources Program was given. A comparison of simulation techniques, where temporal sequences of events are reproduced on electronic computers reducing the time scale from decades to minutes, was made to analytic techniques, where consequences are expressed as explicit mathematical functions of design variables. The simulation model leads to convenient estimates of the consequences of design decisions even in complicated circumstances, but are awkward when a wide range of these decisions has to be evaluated. On the other hand, analytic models cannot be applied to practical problems without drastically simplifying them. It was suggested that the two methods can be used in tandem, with analytic models delimiting the range within which simulation is required. (Gysi-Cornell)
W69-01218

WATER QUALITY IMPROVEMENT PROGRAMMING PROBLEMS,
Stanford Univ., and Stanford Research Institute, Stanford, Calif.
Matthew J. Sobel.
Water Resources Res, Vol 1, No 4, pp 477-487, 4th Quart 1965. 11 p, 12 ref, 1 append.

Descriptors: *Dissolved oxygen, *Standards, Estuaries, Public benefits, Indirect benefits, Direct benefits, *Linear programming, Mathematical models, Optimization, Project planning, Constraints, Social values, Sewage treatment, Diffusion, Waste dilution, *Waste water treatment, Water policy, *Water quality control, Water values.
Identifiers: Delaware Estuary, Delaware River Basin Commission, Mixed integer linear programming.

The nature of regional water quality systems was outlined and programming models for several water quality improvement problems were presented. A linear programming formulation of a static or one-shot improvement in water quality at minimum cost was contrasted with a traditional uniform treatment policy for programming improvements. The constraints for the linear programming formulation were used throughout the remainder of the paper. The traditional policy resulted in a mixed integer problem. The maximization of the ratio of benefits to costs of an improvement program were transformed to a linear programming problem. An expected value formulation of the minimum cost improvement problem under a stochastic environment was given, followed by the quadratic programming problem of minimizing the variance of an improvement program. An application of least-cost models to a water quality improvement program for the Delaware estuary was discussed. The mixed integer linear programming problem was detailed in an appendix. (Gysi-Cornell)
W69-01219

TEMPORAL ALLOCATION OF GROUNDWATER,
Missouri Univ., Columbia.
Oscar R. Burt.
Water Resources Res, Vol 3, No 1, pp 45-56, 1st Quart 1967. 3 fig, 1 tab, 5 ref, 1 append.

Descriptors: *Water management (Applied), Temporal distribution, Surface-ground water relationships, Aquifers, Consumptive use, Dynamic programming, *Economic efficiency, *Future planning (Projected), Pumping, *Groundwater recharge, *Groundwater mining, Marginal productivity.
Identifiers: Decision rule, Present value, San Joaquin Valley (Calif).

A relatively simple economic model for allocation of groundwater either to storage or to immediate pumping was developed. Equilibrium storage was first assumed (constant recharge equalling constant rate of use) and the economic consequences of altering various parameters in the model with respect to the effect on these equilibrium stocks and rates of use were found. The assumption of constant recharge was then relaxed and the concept of a conditional decision rule for stochastic groundwater recharge and the properties of the implied equilibrium were discussed. A hypothetical example was given using estimated pumping costs for the San Joaquin Valley. In its simplest form, the derived decision rule was to equate marginal net output with respect to rate of use to capitalized marginal net output with respect to water stocks. The appendix outlined a procedure for estimation of the value of groundwater stocks as a contingency against uncertain future supplies. (Gysi-Cornell)
W69-01220

HISTORY AND SIGNIFICANCE OF SIMULATION MODELS,
Oregon State Univ., Corvallis.
Louis N. Stone.
The Use of Simulation in Water Research, Semn WR 006.67, pp 1-15, Jan 1967. 9 ref.

Descriptors: *Simulation analysis, Computer models, Analog computers, Analog models, History, Model studies, Systems analysis.

A presentation of the use of models, with emphasis on simulation, was given. Simulation was defined. Models in general were classified and discussed. Classifications included deterministic, stochastic, predictive, normative, gaming, linear programming, and system models. Some historical classical models were described, including resistance, electric circuit, electrolytic tank, nonlinear resistor, and gravitational models. Several illustrative examples of simulation models were given. They included an atmosphere-soil boundary model, an underground water flow model, a flood simulation model, an acoustic ray model, a biochemical systems model, and a 'conditioned response' model. Three simulation programs, called PACTOLUS, MIDAS and DYNAMO, developed for use on digital computers, were mentioned. (Gysi-Cornell)
W69-01221

THE OPTIMIZATION OF SINGLE-PURPOSE RESERVOIR DESIGN WITH THE APPLICATION OF DYNAMIC PROGRAMMING TO SYNTHETIC HYDROLOGY SAMPLES,
California Univ., Los Angeles.
Warren A. Hall, and David T. Howell.
J Hydrol, Vol 1, pp 355-363, Dec 1963. 12 ref.

Descriptors: *Dynamic programming, *Synthetic hydrology, *Reservoir design, *Optimization, Consumptive use, Monte Carlo method, Monetary benefits, Return (Monetary), Correlation analysis, Risks, Water demand, Water policy, Simulation analysis, Hydrograph analysis.
Identifiers: Operating policy.

A method was developed for determining the optimal size of a single-purpose reservoir on a stream with serially correlated annual flows, in order to provide storage for consumptive use. The operating policy on an annual basis was obtained as a consequence of the analysis. The procedure combines dynamic programming sequenced over time, where each time interval could have a different return function, with a Monte Carlo technique using a number of equally likely sample sequences of inflow drawn randomly from a long synthetically generated period of record. The analysis gave an optimum operating policy, the expected value of the optimal return and the degree of risk involved which arises from the hydrologic characteristics of the stream. (Gysi-Cornell)
W69-01222

PLANNING RATIONAL WATER POLLUTION CONTROL POLICIES,
Cornell Univ., Ithaca, N. Y.
Daniel P. Loucks.
Proc Int Conf Water For Peace, Pap No P/39, Washington D C, May 1967. 8 ref.

Descriptors: *Water pollution control, *System analysis, Computer programs, Optimization, Economics, Operations research, *Planning, *Water policy, *Standards, Water quality control, Stream improvement, Stochastic processes, Risk, Evaluation, Probability.
Identifiers: Sensitivity analysis.

The use of systems analysis techniques in the planning and evaluation of water pollution control policies is discussed. Water pollution is defined and present methods for defining pollution control policies are described. The techniques of systems analysis and operations research, such as the mathematics of optimization, economic theory, probability theory and computer programming used for the establishment, improvement, and sensitivity analysis of stream quality standards and design criteria, are examined. The importance of sensitivity analysis in the establishment of rational policies is stressed. The need for basing policies on the minimization of risk of violating quality standards, because of the stochastic nature of stream flows, rather than on deterministic standards is discussed. Additional research areas are suggested. (Gysi-Cornell)
W69-01223

THE ECONOMICS OF CONJUNCTIVE USE OF GROUND AND SURFACE WATER,
California Univ., Davis.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01224

PRELIMINARY OPTIMIZATION OF AN AQUEDUCT ROUTE,
Calif. Univ., Los Angeles; The National Cash Register Co., Hawthorne, Calif.
Warren A. Hall, and John S. Hammond, III.
Amer Soc Civil Eng Proc, Vol 91, No IR1, pp 45-67, Mar 1965. 23 p, 13 fig, 19 ref, 2 append.

Descriptors: *Dynamic programming, *Aqueducts, Terrain analysis, Network design, Water conveyance, Construction costs, Electrical power costs, Fixed costs, Variable costs, Hydraulic gradient, *Economic efficiency, Optimum development plans, Engineers estimates, Surfaces, Marginal benefits.
Identifiers: Lift and reach, Least cost routes, Network analysis.

The preliminary routing of an aqueduct was structured as a network problem. Dynamic programming was used to choose the most economical route from a variety of potential routes. The general problem was divided into three subproblems: (1) the subdivision of the general route area into polyhedron surfaces in order to locate the nodes of the network, (2) lift and reach cost calculations in order to find the minimum link costs, and (3) finally determining the most economic routes connecting any two points in the network. The first two subproblems were discussed in greater detail than the third. Several references were suggested for further study on finding the most economic routes through a network. The optimal path across a plane was shown to be one 'lift' and one or at most two 'reaches.' A numerical example using hypothetical data was presented. Some extensions of the model were proposed for further investigation. (Gysi-Cornell)
W69-01225

PROBLEMS IN DEVISING PROCEDURES FOR APPROXIMATING OPTIMUM SYSTEMS.

pp 86-95 of Entry No. W69-01269 in 05G.

Descriptors: Water pollution, Pollution abatement, *Water pollution control, Cost analysis, Economics, *Model studies, *Optimization, Regional analysis, Systems analysis, Approximation method, *Optimum development plans, Computer programs, Simulation analysis, Input-output analysis, Sequence, Timing, Operations research, Computer models, Project planning, Cost comparisons.

Problems in devising procedures for approximating optimum systems are discussed. Possible alternatives are discussed with respect to a cost minimization objective. Possible use of simulation and programming as aids in planning are noted. Abatement measures and related costs are viewed as inputs and reduction of pollution as the output. The problems of timing and sequence are viewed. It is concluded that the application of operations research techniques merits attention; however, the complexity of such analysis is noted.
W69-01275

HYDROLOGICAL STUDY OF THE LATTON GROUND-WATER SOURCE,
Swindon Corp Water Department, Swindon, Wilts, Great Britain.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-01410

CONTRIBUTION TO THE OPTIMIZATION OF SYSTEM OPERATION BY THE CHOICE OF SUITABLE METHODS OF CALCULATION FOR TRANSIENT STABILITY,
Dresden Technical Univ, Germany.
For primary bibliographic entry see Field 08C.
For abstract, see .
W69-01414

HYDRAULIC MODEL OF RUNOFF FROM DEPRESSIONAL AREAS,
Kentucky Univ., Lexington; Iowa State Univ., Ames.
C. T. Haan, and H. P. Johnson.
Trans Amer Soc Agr Eng, Vol 11, No 3, pp 364-373, May-June 1968. 10 p, 18 fig, 18 ref, append.

Descriptors: *Hydraulic models, *Runoff, *Surface runoff, Mathematical analysis, *Watersheds, Drainage basins, Subsurface drains, Hydrographs, Runoff forecasting, Hydrology, Rainfall, Bibliographies, Atmospheric precipitation, Ditches.
Identifiers: *Hydrologic models, Iowa, *Potholes, *Depression storage, Mathematical models, Subsurface drainage, Runoff hydrographs.

Hydraulics of runoff from depressional areas in north-central Iowa were studied. Definable relationships existed among the geometrical properties of depressions; the frequency distribution of depressional areas can be approximated by a Weibull probability density function. From synthesized mathematical model watersheds, an area of a few square miles had depressions storing more than 1/2 in. of surface runoff. Another mathematical model was developed, capable of simulating runoff hydraulics appearing in drainage ditches less than 48 hr after rainfall. The model had several components, each based on a rational analysis of the process that the component represents. This is a valid method for studying runoff from depressional areas and for investigating the effect of subsurface drainage on peak flows. The effect of changing the values of several variables on runoff hydrographs was investigated. Resulting changes in the hydrographs were on a qualitative basis from a rational analysis of the problem. This indicates that the components of the model represent their respective individual counterparts of the runoff cycle, rather than combining to give a hydrograph that best fits observed data. (USBR)
W69-01436

A DYNAMIC SIMULATION OF THE LOWER KANSAS RIVER DRAINAGE SYSTEM,
Federal Water Pollution Control Administration, Atlanta, Ga; University of Kansas, Lawrence.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01468

6B. Evaluation Process

THE ECONOMICS OF CONJUNCTIVE USE OF GROUND AND SURFACE WATER,
California Univ., Davis.
Oscar R. Burt.
Hilgardia, Vol 36, No 2, pp 31-111, Dec 1964. 81 p, 2 fig, 49 tab, 56 ref, 4 append.

Descriptors: *Conjunctive use, *Dynamic programming, *Linear programming, *Economic efficiency, *Water management, Aquifers, Markov processes, Distribution patterns, Discount rate, Marginal productivity, Water balance, Groundwater recharge, Hydrologic data, Surface-groundwater relationships.
Identifiers: Kings River (Calif), Pine Flat Reservoir (Calif), Present value.

The economics of water resources was discussed with special emphasis on the optimal management of water in existing storage and distribution facilities. Dynamic programming was used to determine the optimal conjunctive use of single and multiple storage facilities. An alternative, requiring only a small computer and simple program, but confident prediction of streamflows, was given. Linear programming was used to estimate the net social benefits and the net output function. A detailed description was given of activity demand functions and the environmental constraints. Surface water policy and the probability distribution and transition probabilities for ground water storage were discussed. Numerical examples were presented with data obtained from a study of the Kings River, Pine Flat Reservoir, California. The empirical results considered present, marginal, and expected values of management policies and the Markovian properties of stochastic hydrology. (Gysi-Cornell)
W69-01224

FEDERAL RESEARCH AND DEVELOPMENT PROGRAMS: DECISION MAKING PROCESS CONVERSION OF DEFENSE RESOURCES WITH EMPHASIS ON EXPANDED PROGRAMS OF URBAN DEVELOPMENT, MASS TRANSPORTATION, AND WATER RESOURCE DEVELOPMENT.
Cornell Univ., Ithaca, N. Y.

Hearings, House Comm on Government Operations, Subcomm on Research and Technical Programs, 89th Cong, 2nd Sess, pp 177-212, 1966. 36 p, 3 append. OWRR Project A-005-NY.

Descriptors: *Diversification, *Water development, Water resources, *Transportation, *Urban renewal, Area development, Questionnaires, Community development, *Industries.
Identifiers: *Defense industries, Cornell U (NY).

This is a report of a study carried out at the School of Industrial and Labor Relations at Cornell University. The research involved collecting facts, investigating attitudes, and analyzing the interactions of groups of people as they attempted to deal with a common problem. Specifically, the purpose was: (1) to determine the extent to which some leading defense contractors are trying to diversify, thereby reducing their dependence on defense business; (2) to identify major obstacles standing in the way of business firms converting some of their resources from defense to nondefense activities; (3) to explore the interest of defense companies in entering the market for expanded programs of water resource development, mass transportation, and urban development; and (4) to examine the potentiality of greater industry and government cooperation in expanded programs of water resources development, mass transportation, and urban development.
W69-01226

WATER RESOURCES RESEARCH AND EDUCATIONAL NEEDS IN MINNESOTA.
Minnesota University, Minneapolis.

Water Resour Res Center Bull 5, Univ Minnesota, Mar 1967. 120 p, 43 fig, 18 tab, 48 ref. OWRR Project A-999-Minn.

Descriptors: *Water resources development, *Resource development, Water pollution, Water supply, Water resources, Recreation, *Education, Water law, Economics, Priorities, Natural resources, Planning, Water quality, Water pollution control, Floods, Minnesota, Economic impact, *Research and development.
Identifiers: Water budget, Water level, Water resources management.

This bulletin is a collection of papers presented at a Conference on Water Resources Research Needs in Minnesota held on November 15-16, 1966 in St. Paul. Results of a questionnaire concerning research need priorities are summarized. Subjects covered in these papers are research needs, water supply, water pollution, floods, land and water, water-based recreation, economic aspects and education in water resources.
W69-01228

STRATEGIES FOR WESTERN REGIONAL WATER DEVELOPMENT,
California University, Berkeley.
Ernest A. Engelbert.
Proc, Western Interstate Water Conf, Corvallis, Oreg, 1965. 195 p.

Descriptors: *Water resources development, Watershed management, Water pollution, Water

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conservation, Water quality, Water utilization, River basin development, Cooperation, Water rights, Policy matters, Weather modification, Feasibility studies, Evaluation, Economics, Benefits, Water harvesting, *Water management (Applied).
Identifiers: Water shortages, Western United States.

Few if any issues are more crucial for the future development of Western states than effective use and management of the region's water resources. Unprecedented population and economic growth during the post war period has resulted in unanticipated water needs and demands. Every state in the West is presently faced with dangerously declining groundwater tables, serious stream pollution, socially disrupting conflicts among water users, and in some communities, critical shortages. Western water development involves many disciplines and facets of knowledge. The range of subject matter is reflected by the contributors to this volume who come from many fields of training and specialization, including the research, policy-making and managerial phases of water use. Their combined talents notwithstanding, the contributors would not claim that their collective papers cover all aspects of this topic. This work is viewed as an introduction for the citizen to a complex field of public and private decision-making.
W69-01244

CRITERIA FOR EVALUATING THE QUALITY OF WATER BASED RECREATION FACILITIES,
North Carolina University, Chapel Hill.
Charles Stott.
Water Resour Res Inst, Univ N Car, Rep 1, 1967. 88 p, 36 photo, 55 ref, 3 append. OWRR Project A-011-NC.

Descriptors: Bibliographies, *Recreation facilities, Recreation, Swimming, Boating, Water sports, Locations, *Evaluation, Design, Field tests, Construction, Maintenance, Safety.
Identifiers: Parking facilities, *Criteria, Selection, Quality levels.

This study is limited to establishing criteria for day use facilities, roads, parking areas, picnic areas, swimming areas and boating areas. The criteria for each of these facilities is further divided into site selection, design, and construction, and state of maintenance and appearance. Many factors affecting quality were listed, checked with professional practitioners, and refined many times, then changed into criteria in the form of questions, followed by an interpretations. The criteria were pretested, refined and tested again in the field. The rating scale for evaluation criteria is given.
W69-01250

ECONOMICS IN INTERDISCIPLINARY WATER RESOURCES ANALYSIS,
Rutgers--The State University, N J.
William Whipple, Jr.
Pap, Amer Water Resour Ass, San Francisco, Calif, Nov 1967. 14 p, 13 ref. OWRR Project A-014-NJ.

Descriptors: *Economics, *Water resources, Analysis, Planning, Taxes, Project planning, Multiple purpose projects, *Optimum development plans, Flood control, Social values, Hydroelectric power, Pollution abatement.

The report outlines some central issues of water resources planning and policy that require economic solutions. The author feels that the economist should assume the key role, although others should assist him in defining the problem and supplying certain parameters. He recommends econometrics and the interdisciplinary approach.
W69-01254

PLANNING FLOOD CONTROL MEASURES BY DIGITAL COMPUTER,
University of Kentucky, Lexington.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01268

WATER POLLUTION - ECONOMIC ASPECTS AND RESEARCH NEEDS,
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-01269

ECONOMIC EFFICIENCY, SOCIAL POLICY, AND THE POLLUTION PROBLEM.

pp 18-28 of Entry No. W69-01269 in 05G.

Descriptors: Impaired water quality, Water pollution, *Water pollution effects, Comparative costs, Economic efficiency, Economic evaluation, *Economic impact, Economics, Efficiencies, Indirect costs, Public benefits, *Welfare (Economics), Political aspects, *Social aspects, Social impact, Social values, Model studies, Public health, Social needs, Benefits.

The ways in which unregulated market results with respect to water pollution fail to coincide with the requirements of an ideally functioning market system are discussed. Some of the directions that appropriate public policy might take are illustrated through the use of a hypothetical basin-wide firm, which recognizes that pollution causes technological links between various activities. It is pointed out that interdependency in consumption and conditions of supply do not yield appropriate social valuations in regard to some aspects of water quality. Political valuations become significant in these instances. It is concluded that none of these considerations negate the rationale of a competitive market system, but rather grow out of such a system.
W69-01271

EVALUATION-DETERMINATION AND INTEGRATION OF INDIVIDUAL AND SOCIAL VALUES--FOCUS OF PUBLIC POLICY.
pp 29-45 of Entry No. W69-01269 in 05G.

Descriptors: *Design flow, Political aspects, *Public benefits, Social aspects, *Social values, Water policy, *Water pollution control, Water resources development, Public health, Pollution abatement, Water pollution, Water pollution effects, Governments, River basin development, Optimum development plans, Specialization, Economic impact.

The social objective of waste water disposal policy and the role of public policy in pollution abatement are considered. Stream specialization techniques are discussed with emphasis on the advantages of specialization and methods of evaluation. The design flow, a general problem in evaluation is discussed in detail. It is concluded that government intervention into the area of disposal of wastes into water bodies cannot only improve efficiency measured in terms of market values, but can and should take explicit cognizance of extra-market values and considerations. It is noted that system planning would ideally consider all alternative uses, but that the inherent complexity of the problem along with conceptual and informational deficiencies make optimum solutions virtually unattainable. A recommended approach is to set out basin-wide pollution control problems in formal terms. It is concluded that considerable research into various areas is essential. Benefit-cost analysis and property values are discussed in appendices.
W69-01272

AN ACT TO CREATE THE SOUTH CAROLINA WATER RESOURCES PLANNING AND COORDINATING COMMITTEE, AND TO PROVIDE FOR ITS DUTIES AND RESPONSIBILITIES.
South Carolina Laws no 61 (1967).

Descriptors: *South Carolina, Legislation, *Administrative agencies, *Water resources development, Water supply, Water quality, Water pollution, Political aspects, Navigation, *Long-term planning.
Identifiers: Water agencies.

The South Carolina Water Resources Committee is created. It is to have eighteen members and their method of appointment and terms are provided. An executive director and staff are to be hired. The committee is to advise the governor and general assembly in: (1) establishing a coordinated and comprehensive state water resources policy; (2) coping with special rural and urban water problems; (3) coordinating state agencies; (4) participating in federal programs; (5) protecting the interests of all groups in representation on interstate water agencies; (6) recommending law revision; and other functions as may be designated by the governor and general assembly. The committee is authorized to carry on studies, hold hearings and to contract with any agency. In connection with its recommendations, the committee is directed to consult with other state agencies, federal, state and local governments, and appoint advisory boards. Considerations such as adequate water supply, water quality, navigation, and watershed management, are to be taken into account by the Committee. (R. F. Williams-Fla)
W69-01337

THE RELATION OF WATER QUALITY TO WATER USERS,
Resources for the Future, Inc.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-01400

WATER QUALITY AND RESOURCES ALLOCATION BY PRIVATE MARKETS,
Resources for the Future, Inc.
Allen V. Kneese, and Blair T. Bower.
In Managing Water Quality: Economics, Technology, Institution, Baltimore: Johns Hopkins Press 1968, Chap. 5, p 75-96, 2 fig, 18 ref.

Descriptors: *Legal aspects, Optimum development plans, Waste discharge, Water quality, *Market value, *Economic justification, Project planning, Costs, Economies of scale, *Water quality management, Judicial decision, Social values, Regional analysis, Regional development, Decision making, Institutional constraints.
Identifiers: Technological external diseconomies, Externalities, Decentralized decision making.

To realize the advantages of decentralized dec sion-making mechanisms ways must be found t optimally control external effects and direct inte dependencies. Technological external diseconomies are illustrated by such problems as air pollution and water pollution. The failure of municip and industrial waste dischargers to consider th subsequent water uses may be made more expe sive or foreclosed entirely by their discharge, is pe haps the basic element of the water quali problem. Examples of how an optimal situation c be achieved through the market is presented. F each level of waste withheld from discharge there an optimum combination of waste withholdi measure which is in turn associated with a certa cost. Although it is possible for market transactio to take externalities into account under certain c cumstances, transactions of this kind are rarely ganized. The damaging effects of waste dischar are diffuse and the linkages between parties co plex, so that establishing a market which wo systematically take account of external costs wo be a complex and expensive procedure. Efforts use litigation to balance costs and returns suf from the same disabilities as market transactio Six deficiencies of legal remedies are discuss Four suggestions for properly structuring the diciary to play a useful and essential supplement role are given. A detailed discussion of the po bility of internalizing the externalities of prod

tion through a basin-wide firm are presented. (Gargola-Chicago)
W69-01401

THE GALVESTON WORK PLAN,
Department of the Interior, Federal Water Pollution Control Administration, and Texas Water Pollution Control Board.
Dan M. Wells, Ernest T. Smerdon, and Earnest F. Gloyna.
Texas Technological College, Texas A and M University, and the University of Texas, 1966, 10 p, 4 fig, 11 append.

Descriptors: Water resource development, *Project planning, *Optimum development plans, Water quality, Economic evaluation, Public benefits, Land use, Municipal water supply, Waste water treatment, Water law, Sedimentation, Phytoplankton, Administrative decisions, Institutional constraints, Models, Financing.
Identifiers: Galveston Bay, Texas, Recreation benefits.

The work plan was designed to develop a comprehensive study of the Galveston Bay area which would provide a sound water quality management plan. The work proposed is divided into four functional categories of projects. The first functional category is concerned with the evaluation of costs of making incremental improvements in water quality for both present and future conditions and for a variety of treatment programs. The second category attempts to evaluate the social benefits associated with improvements in water quality. The evaluation of the benefits to marine life associated with incremental improvements in water quality is the third functional category. The fourth category uses results obtained in the first three along with legal research and mathematical modeling techniques to determine the optimum feasible water quality management program. Estimates of the budget are presented and the necessary organizational structure outlined. The organization would include a (1) policy making group, (2) project manager, (3) technical advisory group, (4) specialist in budget control and contracting, (5) specialists in water quality management, marine biology and ecology, land use planning, economics, and recreation, and optimization and computer applications, and (5) task forces for coordinated attack on problems. A schedule detailing the expected progress through time of the organization is put forth. (Gargola-Chicago)
W69-01404

ECONOMIC DERIVATION OF RESERVOIR OPERATING RULES,
Kentucky Univ, Lexington, Civil Eng Dept.
L. Douglas James.
ASCE Proc, J of Hydraulics, Vol 94, No HY5, Pap 6111, pp 1217-1230, Sept 1968. 14 p, 4 fig, 7 tab, 10 ref.

Descriptors: *Flood control, Multiple-purpose reservoirs, Optimum development plans, *Recreation, *Reservoir operation, *Water supply, Water law, Water transfer, Simulation analysis.
Identifiers: *Economic simulation models, Rough River Reservoir.

Rules prescribing the amount of water which should be kept in a reservoir on a month by month basis throughout the year are needed to maximize benefits from operation of existing reservoirs or from operation of reservoirs being considered in system planning. Economic tradeoffs were used to resolve the conflicting storage requirements of flood control, recreation, and water supply in accordance with monthly demand patterns. Total potential benefits and economic loss functions for each of the three purposes were derived and used to derive a set of curves for determining optimum storage in Rough River Reservoir, Kentucky, for each month of the year. Practical and legal problems expected in implementing such rules are discussed. (Author)
W69-01406

OPTIMISATION IN THE USE OF THE MEANS OF PRODUCTION AND TRANSMISSION,
M. Adnet, P. Auges, and M. Dupoux.
Int Conf Large High Tension Elec Syst, Paris, France, June 1968. Pap 32-15, 34 p, 8 fig, 2 ref, 4 append.

Descriptors: *Electric power production, Optimum use, Economics, Water utilization, *Transmission (Electrical), Calculations, Models, Reservoir operation, *Power system operations, Hydroelectric power, Thermal power, Foreign countries, Operations, Mathematical analysis, Irrigation, Water requirements.
Identifiers: France, Interconnected systems, Energy budget, Energy transfer.

Objectives and methods used by Electricite de France in operating its complex system of thermal and hydroelectric powerplants to assure uninterrupted electrical energy to that country are described. Problems involved in obtaining maximum utilization of the equipment, overall powerplants, existing transmission network, and fuel reserves are considered. Managing hydraulic reservoirs for most effective use is discussed. Coordination of powerplants within the same valley must be considered for the best economic management of water supplies derived from drainage areas. Daily programs of starting and stopping generating units are important for economic system operation. The influence of system calculation must be considered for economic control of production and consumption. The essential task is to ensure the supply to consumers under correct conditions of frequency and voltage, while managing production of electric energy in the most economic manner. (USBR)
W69-01422

OPTIMUM PENSTOCK DIAMETER FOR HYDROELECTRIC POWERPLANTS AND PUMPING PLANTS,
California State Department of Water Resources, Sacramento.
Ravinder K. Jain, and A. R. Griffith.
Tech Memo No 34, Dept Water Resour, State Calif, June 1968. 25 p, 2 fig, 2 tab, 9 ref, append.

Descriptors: *Penstocks, *Hydroelectric powerplants, *Pumping plants, Economics, *Optimum design, Head losses, Cost comparisons, Steel plates, Computer programming, Mechanical engineering, Stress analysis, Friction, Excavation, Backfills, Protective coatings, Manning formula, Planning, Costs, Construction costs, Steel pipes.
Identifiers: Tehachapi Pump Plant (Calif), *Computer programs, Annual costs, *Computer-aided design, California, California State Water Proj.

An economical method is outlined for determining the optimum penstock diameter for hydroelectric powerplants and pumping plants, based on a minimum total annual cost. This total annual cost includes all costs of construction and the cost of power loss due to friction. All such factors are brought explicitly into the cost analysis utilizing a computer program. Laborious calculations are avoided and the relationships existing between the various cost aspects may be studied in greater detail because of the basic simplicity of this approach. Total computer cost is approximately $1.50 for 2 sets of data. This method was developed while designing the Tehachapi Pumping Plant Discharge Lines. The computer input and output, example cases, and program listings are given. (USBR)
W69-01431

BULGARIA'S HYDRO-POWER POTENTIAL,
Liubomir S. Yordanov.
Water Power, Vol 20, No 9, pp 368-375, Sept 1968. 8 p, 6 fig.

Descriptors: *Hydroelectric powerplants, Rainfall, Runoff, Underground powerplants, *River basin development, Pumped storage, Project planning, Snowmelt, Multiple purpose projects, Municipal water, Irrigation, Dams, Industrial water, Reservoirs, Pressure tunnels, Electric power, Geology, Foreign projects.
Identifiers: Bulgaria, *Hydroelectric resources, Water use, Watershed management, Europe, *River cascade systems.

Hydroelectric and pumped storage plants in service, under construction, or proposed in Bulgaria are described. Geomorphological, climatic, hydrological, soil, and biogeographical characteristics of the region are discussed. Data are given for each existing hydroelectric installation. River cascade systems under construction are described. In addition to the principal cascades, there are 58 reservoir sites with dams exceeding 15 m high, and 65 hydroelectric powerplants under construction. Potential developments planned for the next 10 to 12 yr are listed. Problems that must be considered in Bulgaria's hydroelectric power development include: insufficient rainfall; dry climate; and the inadequate system of natural river courses, rockfalls, vertical cliffs, and avalanches. Pumped storage is considered as a solution to these problems. One small experimental pumped storage plant exists, but others are under construction or planned. Bulgaria's power generating potential characterizes the general economic growth. Power output has increased from 45 kwh per capita in 1944 to 1400 kwh in 1966, and is expected to reach 2500 kwh in 1970 and 4500 kwh in 1975, the highest in the Balkans. (USBR)
W69-01451

SURVEY CONTROL FOR CONCRETE DAM CONSTRUCTION,
Bureau of Reclamation, Montrose, Colo.
Maynard J. Willis.
Proc Amer Soc Civ Eng, J Surv Mapp Div, Vol 94, No SU2, pp 169-188, Sept 1968. 20 p, 11 fig, 1 tab, 3 ref, append.

Descriptors: *Surveying, Surveying instruments, Concrete dams, *First order surveys, Construction, Second order surveys, Offsets, Bench marks, Monuments, Plane surveying, Theodolites, Triangulation nets, Arch dams.
Identifiers: *Surveys, *Morrow Point Dam (Colo.), Construction control, Construction practices.

Precision survey controls for Morrow Point Dam, a double-curvature, concrete-arch structure, 465 ft high, were required through reconnaissance, site investigation, and preconstruction phases to satisfy specific needs of the designers, and to accommodate the rough terrain. Surveys for this type of project can be grouped into 2 convenient classifications; control and construction. Control surveys are directly related to geodetic principles. Construction surveys are used under localized application of plane surveying for structure layouts. Horizontal control surveys for Morrow Point Dam consisted of a triangulation grid based on the state coordinate system. Vertical control was elevation in feet above mean sea level, datum of 1929. After completing excavation for the access roads, a primary triangulation network was established with stations located adjacent to the powerplant open-cut area and the keyways for the dam. The method used in adjusting the triangulation scheme is presented. A series of bench marks was established from a line of first-order leveling by the U S Coast and Geodetic Survey, and extended the leveling to the vicinity of the primary features of the project. An electronic computer processed repetitious surveying calculations. (USBR)
W69-01457

WATER IMPORT SYSTEMS FOR ARID LAND DEVELOPMENT.
Ralph M. Parsons Co., Los Angeles, Calif.

International Symposium About Increasing of Food Production in Arid Lands, Instituto Tecnologico de Estudios Superiores Monterrey, Monterrey, Nuevo Leon, Mexico, April 22-25, 1968. 16 p, 3 map, 2 tab.

Descriptors: *Arid lands, *Water resources development, *Geographical regions, *Climatology, Mexico, *Reservoir storage, Water transfer, Economic feasibility, Rivers, Canals, Tunnels, Water shortage, Hydroelectric power, Natural resources.
Identifiers: *North America Water and Power Alliance, Canada, American Desert.

The North American Water and Power Alliance is thoroughly discussed in this article. The NAWAPA concept utilizes geographical and climatological features of the North American Continent to collect and store excess water of northwestern areas of the continent and distribute it to arid areas of Canada, the United States and northern Mexico. The concept envisions water deliveries from these surplus areas in times of drought into the American Desert about 9 years after initiation. The NAWAPA is economically feasible and financially within the existing money markets. (Blecker-Ariz)
W69-01471

ECONOMIC FACTORS IN THE IMPROVEMENT OF ARID AND SEMI-ARID GRASSLANDS,
Forest Service, Division of Range Management.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-01482

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

A SOCIALLY OPTIMUM PRICING POLICY FOR A PUBLIC WATER AGENCY,
Washington Univ., Seattle; California Univ., Berkeley.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-01215

THE MARKET FOR WATER BASED OUTDOOR RECREATION SERVICES IN NEW CASTLE COUNTY, DELAWARE,
Delaware Univ, Newark.
Paul Seidenstat.
Univ Delaware Water Resources Center Contrib No 2, July 1966. 66 p, 5 fig, 18 tab, 55 ref, append. OWRR Project A-003-Del.

Descriptors: *Marketing, *Recreation, Recreational facilities, Water resources, Outdoors, Boats, Fish, Swimming, Public services, Statistics, Bibliographies, Delaware.
Identifiers: New Castle County (Delaware), Water use.

Under a grant for the Water Resources Center of the University of Delaware acting under the Federal Government's Water Resources Research Act of 1965, an investigation of the allocation and development of the water related recreation market in New Castle County, Delaware, was undertaken. In the process of this research activity, the author found it helpful to develop a framework for the analysis, pulling together much of the literature in this field. What has emerged, we hope, is more than just a study of water resource development in one county but a framework to facilitate rational choice-making at the local governmental level everywhere.
W69-01234

WATER AND SEWER BOND SALES IN THE UNITED STATES, JANUARY - DECEMBER 1966.
Federal Water Pollution Control Administration, Washington, D C.

FWPCA Grant WP-00016, Fed Water Pollut Contr Admin, Div Pollut Surveillance, Jan-Dec 1966. 10 p, 14 tab.

Descriptors: *Sewers, *Construction costs, Costs, *Financing, Interest rate, Interest, Investment.

This annual report of Water and Sewer Bond Sales in the United States contains data which are basic and necessary to the orderly and efficient management of water supply and pollution control programs. It reflects, in a measure, the extent of financing to fulfill these two important public services. The report also provides a ready source of economic reference for financial, investment and banking interests; for the building and contracting trades and professions; and for authorities responsible for providing public water supplies and sewerage systems. The publication series, over the years, is a good indicator of interest rate and construction cost trends in these two types of public utility. Data are presented in three categories according to the use of the proceeds from the sale: (1) Water, when the bonds have been sold to finance water facilities; (2) Sewer, to finance sewage facilities; and (3) Combination, to finance jointly water and sewage facilities where the portions attributable to each type are not designated. Data describing bonds sold to finance other types of construction in combination with water and/or sewage facilities construction are excluded. Data describing bonds sold to finance storm sewers are omitted, although these data are available. (Author)
W69-01245

IMPACT AND INCIDENCE OF TAXATION ON WATER UTILITIES IN RHODE ISLAND,
Rhode Island University, Kingston.
Marvin Pitterman.
Univ Rhode Island Completion Rep A-005-RI, June 1966. 23 p, 8 tab, 15 ref. OWRR Project A-005-RI.

Descriptors: Bibliographies, *Public utilities, *Taxes, Analytical techniques, *Rhode Island, Analysis, Income, Investment, *Water supply, Economic impact, Population, Community development, Economics.
Identifiers: Economic evaluation.

This paper is a study of effect of taxation on water utilities in Rhode Island. It involves a detailed study of 6 private or quasi-municipal water utilities in Rhode Island with great disparity in size. The method of descriptive research was used to develop and solve problems by obtaining and interpreting necessary information and data. Facts used in this approach were obtained principally from Rhode Island Utilities Commission, annual reports of the 6 utilities, articles in daily newspapers, and interviews with local water authorities. Important conclusions reached were: (1) taxes do not detract from private or quasi-municipal water utilities development; (2) utility taxation does not lessen quality of service to the consuming public; (3) the private or quasi-minicipal water utility bears the impact of utility taxation; (4) the incidence of utility taxation is borne by the consuming public; (5) rate increases must be slightly higher due to utility taxation; (6) the Utility Commission protects the consumer from unwarranted rate increases and (7) the utility taxation does not prevent water utilities from servicing expanding areas.
W69-01258

VILLAGE OF ALBANY V GREATER LIVINGSTON WATERWORKS CO)TRANSFER OF WATERWORKS FRANCHISE(.

193 So 2d 110-114 (Ct App La 1966).

Descriptors: *Louisiana, *Water works, Water rates, Utilities, Legal aspects, Judicial decisions, Local governments, Contracts.
Identifiers: Franchises.

Village of Albany seeks to have franchise holder's transfer of waterworks franchise to water company declared invalid. The Louisiana Court of Appeals held that referendum approval of a franchise grant was not required where tax dollars were not being used in the construction and operation of the franchise system. Even if approval of the mayor and aldermen were necessary before a franchise could be transferred by its holder to another, such approval had already been given in the present case by the grant of the franchise to the holder, 'his heirs, successors, or assigns.' Language of a statute that provided that a municipality 'may' authorize or assent to all transfers of franchises by the grantee and its successors, and assigns was permissive in nature. A municipal corporation may regulate rates on a system it owns or leases, but in nearly all other cases the Louisiana Public Service Commission regulates rates of privately owned utilities. (P. N. Smith-Fla)
W69-01379

STANDARDS, CHARGES, AND EQUITY,
Resources for the Future, Inc.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-01402

6D. Water Demand

HACKENSACK WATER CO V BOROUGH OF UPPER SADDLE RIVER)ADMINISTRATIVE STANDARDS FOR WATER DIVERSION(.

88 N J Super 362, 212 A 2d 394-402 (1965).

Descriptors: *New Jersey, Administrative agencies, *Administrative decisions, *Diversion, Diversion losses, Judicial decisions, Legislation, *Water law, Water permits.
Identifiers: Minimum flow.

The case involved an appeal by a New Jersey borough and village from a determination of the Water Policy and Supply Council granting an application by Hackensack Water Company for approval of a diversion of water from the Saddle River by two wells. According to New Jersey law in order to merit the Council's approval proposed plans for water diversion must: (1) be justified by public necessity; (2) provide for proper and safe construction of facilities; (3) provide for the prevention of contamination; (4) insure that any resulting reduction in the dryflow of a stream will not produce unsanitary conditions or otherwise injure public or private interests; and (5) be just and equitable to municipalities and their inhabitants with regard to present and future water needs. The court held that since the Council's decision did not so depart from the record evidence as to become arbitrary, capricious or unreasonable, it would not be set aside. The court noted that if conditions changed or if something was overlooked, the Council's decision was subject to review at any time in the public interest. Administrative law arguments were also discussed. (Patterson-Fla)
W69-01394

ENVIRONMENTAL ANALYSIS AND REMOTE SENSING,
Cold Regions Research and Engineering Laboratory, Hanover, N. H.
J. N. Rinker, and R. E. Frost.
Seminar, Amer Inst Aeronaut Astronaut, Rocky Mt Sect, Colorado State Univ, Fort Collins, July 1968. 152 p, 34 fig, 2 tab, 388 ref, append.

Descriptors: *Sensors, *Aerial photography, *Environment, Photography, Population, *Population growth, Foods, Water supplies, Land utilization, Waste disposal, Water pollution, Agriculture, Bibliographies, Acoustics, Radar, Crops.
Identifiers: *Photointerpretation, *Remote sensing, Images, Aerial reconnaissance, Environmental effects, Environmental engineering.

The need for environmental analysis is apparent when the world population explosion problem is considered. The environment that must satisfy the needs and desires of the expanding population is not inexhaustible; its components are so inter-

lated that a beneficial utilization of one can result in an unintended but detrimental influence on another. The increase in population may someday exceed our ability to house and feed people on a worldwide basis. Water demands rise with population increase and per capita requirements. The problems of waste disposal and pollution resulting from these increases are discussed. Remote sensing techniques could be a great aid to man as he studies his environment. Techniques and applications of photography, thermal sensing, radar, and acoustical sensors are discussed. An example demonstrates the amount and type of information that can be obtained from a detailed stereoscopic study of aerial photography. (USBR)
W69-01467

6E. Water Law and Institutions

WATER RESOURCES ADMINISTRATION IN DELAWARE,
Delaware University, Newark.
Roger Smith Hoeh.
Univ Del Water Resour Center Contrib No 1, Aug 1966. 175 p, 3 fig, 1 map, 122 ref. OWRR Project A-003-Del.

Descriptors: *Water resources, Water management, *Water resources development, Water sources, Governments, Interstate compacts, Surface waters, Water conservation, Water pollution, Groundwater, *Delaware, Legal aspects.
Identifiers: Delaware River Basin, *Water resources management.

The structure and functions of Delaware governmental agencies concerned with water resources are discussed. Future legal problems associated with water resources are apt to be concerned with the state's basic need: (1) to clearly define the scope of water rights; (2) to provide some mechanism for implementing and enforcing a water resources plan; and (3) to create a central advisory, information and policy coordinating center at the state level. Administratively, planning and development activities are conducted by separate agencies directly responsible to the Governor, while the other agencies are considered to be legally and formally autonomous. Delaware agency administrators depend to a considerable degree on informal agreements with their counterparts in other states. These agreements may attain a degree of permanence comparable to a formal, written agreement as the practice continues over an extended period.
W69-01230

PROBLEMS ARISING OUT OF MONTANA'S LAW OF WATER RIGHTS,
Albert W. Stone.
OWRR Project A-002-Mont, Mont Law Rev, Vol 27, pp 1-18, 1965. 18 p.

Descriptors: *Water law, *Montana, *Water rights, Legal aspects, *Prior appropriation, Beneficial use, Adjudication procedure, Permits, Legislation, Administration, Water resources development.

Montana is limited in developing water resources by laws and administrative patterns which were formed before Montana became a state. It still recognizes 'use' rights--appropriations acquired without posting, filing, declaring or stating anything. This results in an indeterminate right, which must ultimately be established by future litigation, when the facts are most difficult to establish. In the meantime other developments are inhibited. The optional 'statutory method' of appropriation provides for local filing prior to commencement of works, and results in no record of the quantity of water actually appropriated upon completion, nor even whether any appropriation was completed. On adjudicated streams a court proceeding is required for appropriation. Although water rights may be transferred, the transferor can transfer no better right than he had, and hence the transferee cannot use water in an amount or manner which is more burdensome. The transferee is limited to that which would have been the needs of his transferor. There is a need to turn to a completely administrative system for ascertaining existing rights, permitting future appropriations which are consistent with the public interest, and administering water distribution. (Author)
W69-01233

LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
Iowa University, Iowa City.
For primary bibliographic entry see Field 04D.
For abstract, see .
W69-01255

UNCERTAINTY IN WASHINGTON WATER RIGHTS,
Washington University, Seattle.
William Van Ness.
Water Resour Res Center, State Washington, Completion Rep, Feb 1967. 38 p, 4 append. OWRR Project A-002-Wash.

Descriptors: *Public rights, Reparian rights, Water allocation (Policy), Water rights, Water law, Water permits, Decision making, *Adjudication procedure, *Judicial decisions, Prior appropriation, Legislation.

The purpose of this paper is to objectively determine, insofar as presently available data allows, the present extent to which the central recording system for water rights and the procedures for making water rights a matter of record are sources of general uncertainty and title insecurity problems in the state of Washington. The primary analytical method chosen has been a detailed study of the decrees rendered in the fifty-eight statutory stream bed adjudications which have to date been conducted in this state. A secondary approach has involved a consideration of the Washington statutes and case law on water rights in an attempt to determine what role they play in eliminating or compounding title insecurity and problems of uncertainty now found in Washington water law. Because of the substantial similarity in the water law of the western states which follow the appropriation doctrine it is believed that the results of this study are indicative of problems-latent and apparent- in other states. (Author)
W69-01261

LEGAL ASPECTS OF WEATHER MODIFICATION--SNOW PACK AUGMENTATION IN WYOMING,
Wyoming University, Laramie.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-01263

HANDBOOK OF BASIC WATER LAW,
Louisiana State Univ., Baton Rouge.
George W. Hardy, III.
La Water Resour Res Inst, Bull 1, June 1966. 77 p. OWRR Project A-001-La.

Descriptors: *Civil law, *Water rights, Legislation, *Water law, State jurisdiction, Administrative agencies, Appropriation, Eminent domain, Withdrawal, Water conservation, Water pollution, Irrigation, Louisiana, *Water districts.
Identifiers: Baton Rouge Area (La).

The materials compiled in this bulletin are intended to form a basic handbook for the further study of possible solutions to the legal problems encountered in the study of salt water intrusion into aquifers utilized as a source of fresh water in East Baton Rouge Parish and the surrounding area. The bulletin consists of 3 parts: (1) a memorandum by Dean Frank Trelease of the University of Wyoming College of Law exploring problems of water conservation on a broad scale; (2) collected memoranda summarizing the law of several states other than Louisiana which have faced problems of water use and conservation; and (3) a compilation of relevant statutes and court decisions regarding water law, water use and control, and water conservation in Louisiana. This material will furnish a basis for more specific study and planning when sufficient geological, economic, and engineering data have been procured to permit the conception and presentation of plans for legal action to assure a steady supply of fresh water for industrial and domestic use.
W69-01267

DUVAL V THOMAS)RIGHT TO USE OF ENTIRE NONNAVIGABLE LAKE BY OWNER OF A PORTION OF THE LAKE(.
State of Florida, Tallahassee.

114 So 2d 791-795 (Fla 1959).

Descriptors: *Florida, Judicial decisions, Lakes, *Reasonable use, Barriers, Limiting factors, Access routes, Nonnavigable waters, *Boundaries (Property), Legal aspects, *Tourism.

Petitioners owned land on either side of respondant. Each constructed a barrier extending into a landlocked, nonnavigable lake to a corner common to all the parties, the result being to block respondant's access to the rest of the lake. Respondant brought an action to have the barriers removed, which was granted. The Supreme Court granted certiorari based on a possible conflict between common law and civil law rules. Petitioners urged the common law rule that the owner could use only that water overlying his fee. The court rejected this contention, stating that they were bound to the common law only when it was clear and directly applicable. An owner of a portion of a lake was entitled to reasonable use of the entire lake as long as he does not interfere with the rights of others. The court cited tourism as an important consideration in this ruling. (Sisserson-Fla)
W69-01278

ANDERSON V COLLINS)SALE OF SOVEREIGNTY LANDS(.
State of Florida, Tallahassee.

111 So 2d 44-50 (2d D C A Fla 1959).

Descriptors: *Florida, Judicial decisions, *Administrative agencies, Beds, Islands, *Riparian rights, Remedies, Legal aspects, Administration.
Identifiers: *Sovereignty lands, Sale of land.

Appellants brought an action to void the sale of sovereignty lands, islands and submerged lands to private parties. Appellants alleged gross abuse of discretion by the Tenatees of the Internal Improvement Fund, the agency which controls title to the tidal lands of Florida. Appellants, citizens of St. Petersburg, joined the city of St. Petersburg as defendants since, as owners of the upland adjacent to the land in question, they did not raise objections to the sale. Appellants contended that the private parties fraudulently represented that they were the owners of the uplands adjacent to the sovereignty lands to be sold, and that the Trustees failed to investigate that claim. The trial court found that the Trustees carefully and correctly followed the statutory procedure for the sale of sovereignty lands. They satisfied the only objection that was raised. The judgment was affirmed. (Sisserson-Fla)
W69-01280

UNITED STATES V 2979.72 ACRES OF LAND)CONDEMNATION PROCEEDING(.

270 F 2d 707-714 (4th Cir 1959).

Descriptors: *Judicial decisions, *United States, Water law, Legal aspects, *Condemnation, *Eminent domain, Navigable waters, Riparian rights, Market value, Severance, Flow.

Identifiers: Flowage easements.

An electric power company purchased a flowage easement from a riparian owner. Then, the fee owner conveyed the fee to the United States for 1 dollar. The United States after condemning the flowage rights contends that the power company should have no compensation because the right has no value since the power company has no right to use the waters of the navigable stream. The court held that although the power company could not use the stream for power purposes without the United States' approval, the United States could not use the land either as long as the power company possessed the easement. Compensation was thus due for losing the right to flow. The measure of the damage is the difference between the fair market value of the land before and after the taking of the easement. Included in these damages was compensation for severance because the power company in purchasing the easement had also purchased the executory right to sever lands not actually covered by the easement rights. (Childs-Fla)
W69-01283

DIVISION OF WATER RIGHTS AND OTHER INCORPOREAL HEREDITAMENTS; PARTITION OF WATER IN A NATURAL STREAM, ETC.
State of Massachusetts, Boston.

Mass Ann Laws Ch 241, Secs 36-37 (1967).

Descriptors: *Massachusetts, Legislation, *Water rights, *Equitable apportionment, Administration, *Non-navigable waters, Riparian rights.
Identifiers: Division of rights.

Sec 36 provides that joint tenants or tenants in common of an incorporeal hereditament such as a mill privilege or water right may be compelled to divide such right in the same manner as provided in this chapter (relating to partition of land) for division of real property. The commissioners appointed to make the partition shall recommend the best method of setting off the respective shares, and the court may make equity-type decrees and orders pursuant thereto. A sale is authorized, where one of the joint owners so requests. Sec 37 provides that partition may be made of a non-navigable natural stream, where the banks are owned by different riparian proprietors. (Williams-Fla)
W69-01291

GOVERNOR AND COUNCIL TO REPRESENT COMMONWEALTH IN U S GOVERNMENT SURVEYS.
State of Massachusetts, Boston.
For primary bibliographic entry see Field 07A.
For abstract, see .
W69-01294

DIVISION OF WATER POLLUTION CONTROL.
State of Massachusetts, Boston.

Mass Ann Laws, Ch 21, Secs 26-50 (1967).

Descriptors: *Massachusetts, *Legislation, *Administrative agencies, Water pollution, Water quality, Water conservation, Water districts, Sewage, Industrial wastes, Federal government, Standards, Reservoirs, Pollution abatement, *Water management, Financing.

The Mass Clean Waters Act created the Division of Water Pollution Control to supervise the prevention, control, and abatement of water pollution. These statutes designate the structure and purposes of the division, which include: (1) Encouragement of cities to adopt water pollution plans; (2) Cooperation with federal and state agencies; (3) Research; (4) Adoption of water quality standards; (5) Periodic examinations of water quality; and (6) Preparation of a state water pollution plan. The division is authorized to establish, consolidate, or dissolve water pollution abatement districts. The water resources commission may construct reservoirs to regulate the water flow. The Director of the Division of Water Pollution Control or his representative is authorized to enter any land at reasonable times to inspect or test for water pollution. A $100 per day penalty is provided for persons guilty of causing water pollution. All new outlets for discharge of sewage or industrial wastes require a permit from the division. The director may issue the permit under whatever conditions necessary to protect the water quality. If the conditions are not met the violator may be enjoined by the Supreme Court. (Watson-Fla)
W69-01296

SECS 143-354 ORDINARY POWERS AND DUTIES OF THE BOARD OF WATER RESOURCES--SECS 143-355 TRANSFER OF CERTAIN POWERS, DUTIES, FUNCTIONS AND RESPONSIBILITIES OF THE DEPARTMENT OF CONSERVATION AND DEVELOPMENT AND OF THE DIRECTOR OF SAID DEPARTMENT.
State of North Carolina, Raleigh.

North Carolina Laws Ch 1071, 1117 (1967).

Descriptors: *North Carolina, Legislation, *Administrative agencies, Administration, Long-term planning, Federal government, Project planning, *Water storage, Local government, Political aspects, Wells, *Well regulations, Water use.

Sec 143-354 provides that the Board of Water and Air Resources is to carry out a program of planning and education with reference to conservation and beneficial use of water resources. It is to: (1) investigate local governments' needs for federal water supply storage projects; (2) warn them of impending water shortages; (3) suggest legislation; (4) hold public hearings; (5) adopt rules and regulations; (6) provide federal agencies with assurances of nonfederal cooperation in federal projects; and (7) to assign or reassign to local governments any interests of the state in federal water storage projects. Sec 143-355 sets out the duties of the Department of Water Resources. The Department is to act as an intermediary with the federal government, engage in studies and long-range planning, administer water related programs, and carry on various other activities. Well drillers are required to register with the Department, supply it with samples of cuttings, and furnish certain information upon completion of the well. Upon request, water users may be required to provide water use information to the Department. (Williams-Fla)
W69-01299

GEORGIA WATER QUALITY CONTROL ACT.
State of Georgia, Atlanta.

Ga Code Ann, Secs 17-501--17-530 (1967).

Descriptors: *Georgia, Legislation, *Administrative agencies, Regulations, *Water resources, *Water quality control, Water pollution, Sewage, Industrial wastes, Project planning, Permits, Standards, Surveys, Water purification.
Identifiers: Federal Water Pollution Control Act, *Div for Ga Water Quality Control.

The policy of the Act is to utilize the water resources of Georgia to the maximum benefit of the people. To achieve this result, a water quality control program is established. The composition and organization of the Water Quality Control Board, which administers this program, are described. Among the powers and duties of the Board are: (1) engaging in research related to pollution; (2) determining the existing pollution conditions; (3) preparing a plan for pollution prevention; and (4) establishing standards of water purity. The Act sets forth the powers and duties of the executive secretary for the Division for Georgia Water Quality Control. All employees of the Division are controlled by the state merit system. All facilities, personnel, funds and functions utilized for water quality control by any state agency are transferred to the Division for Georgia Water Quality Control. The Act makes the disposal of sewage, industrial wastes, or other wastes into waters of the state unlawful except when in compliance with the specified regulations. The methods for enforcing and appealing regulations are described. The Water Quality Control Board is the state agency for all purposes of the Federal Water Pollution Control Act. (Childs-Fla)
W69-01300

WATER RESOURCES CENTER)GA. INST. OF TECHNOLOGY(.
State of Georgia, Atlanta.
For primary bibliographic entry see Field 09A.
For abstract, see .
W69-01301

CANAL COMPANIES.
State of Georgia, Atlanta.

Ga Code Ann Secs 17-101--17-114 (1967).

Descriptors: *Georgia, Legislation, State jurisdiction, *Canals, *Canal construction, *Navigation, State governments.

A petition to the Secretary of State is required of any group of persons desiring to incorporate a company for the purpose of constructing, operating and maintaining a canal. The Secretary of State shall issue a 30 year certificate, to be kept on file. Procedures for organization are set out. The powers of the corporation, such as to make contracts, acquire property and construct canals, are delineated. The corporation may not obstruct navigation, and several other duties and limitations are imposed. The corporation is authorized to enlarge canals, allow others to withdraw waters from their canals, and permit goods to be transported through them. Whenever a canal or its backwaters encroach upon a public road, the corporation must restore the road to its original condition, by the use of bridges, etc., at its own expense. The corporation is authorized to sell, lease or mortgage its property in order to obtain money to maintain its works. The corporations created hereunder shall be subject to taxation. (Williams-Fla)
W69-01302

AN ACT TO AMEND...AN ACT CONCERNING THE ESTABLISHMENT, DEVELOPMENT AND OPERATION OF PUBLIC PORTS, CREATING THE INDIANA PORT COMMISSION AND DEFINING ITS POWERS AND DUTIES.
State of Indiana, Indianapolis.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01303

AN ACT CREATING A POLLUTION CONTROL AGENCY AND CREATING AN OFFICE OF DIRECTOR THEREOF: PROSCRIBING THEIR POWERS AND DUTIES: EMPOWERING THE GOVERNOR TO ACT IN AN EMERGENCY.
State of Minnesota, St. Paul.

Minnesota Laws Ch 882 (1967).

Descriptors: *Minnesota, Legislation, *Administrative agencies, Water quality, *Water pollution control, Administration, *Air pollution, Land use, Solid wastes.

The seven-member Minnesota pollution control agency is created. It is to be broadly representative of skills and experience necessary to carry out the purpose of this act. This agency takes the place of the water pollution control commission, and inherits its powers and responsibilities. The office of director is established, and he shall be appointed by the governor. The director is to organize the commission, is authorized to enter contracts, and is designated the state's agent in applying for, receiving and disbursing federal funds. Assistance from

other state agencies may be required, upon request to the governor. The provisions relating to water pollution are contained in Chapter 115 of the Minnesota Statutes. The powers provided in this act relate to air pollution. A study of solid waste control and land uses in areas affected by air and water pollution is directed. (Williams-Fla)
W69-01304

AN ACT TO PROTECT THE PUBLIC HEALTH AND TO CONSERVE AND PROTECT THE WATER RESOURCES OF THE STATE.
State of Indiana, Indianapolis.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01305

AN ACT AMENDING THE ACT OF MAY 15, 1945)PL 547(, ENTITLED, AS AMENDED, 'AN ACT RELATING TO SOIL CONSERVATION AND SOIL EROSION...'.
State of Pennsylvania, Harrisburg.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-01308

AMENDMENT TO THE SANITARY WATER BOARD ACT OF 1951.
State of Illinois, Springfield.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-01309

RATIFICATION OF THE UPPER MISSISSIPPI RIVERWAY COMPACT BY THE STATE OF ILLINOIS.
State of Illinois, Springfield.

Illinois Laws 1967, Ch H 756.

Descriptors: *Illinois, *Interstate compacts, Regional development, Administrative agencies, Legal aspects, Administration, Financing, Taxes, *River basin development, Interstate commissions, *Mississippi River Basin, Legislation, State governments, Federal government, Water law, Water law, Water districts, Water resources development, Planning, Water policy, Standards.

The upper Mississippi Riverway Compact between the states of Iowa, Minnesota, Wisconsin and Illinois is herein set out and ratified by the State of Illinois. The Upper Mississippi Riverway Commission is established. The Commission is specifically empowered to establish and maintain recreational facilities and programs; to promulgate plans for pollution abatement, control of erosion, and diversions of waters; to hold public hearings; and to make contracts. Generally, the Commission's powers are expressed in broad terms with emphasis upon co-ordination of all state and federal programs within the region. Representation on the Commission is required to be equal among member states, and taxes imposed by the Commission and approved by the states' legislatures are to be apportioned equally. Ratification by three states is required to effectuate the compact. A party state may withdraw by enacting a repealing statute. The Director of Conservation in Illinois is appointed as one of the state's commissioners, and fifty-thousand dollars is appropriated to the Commission. (Pfeiffer-Fla)
W69-01310

PURE WATERS DEVELOPMENT ACT.
State of Illinois, Springfield.

Illinois Laws ch H 1245 (1967).

Descriptors: Legal aspects, Legislation, Local governments, State governments, Water law, *Water resources development, Water pollution control, Water policy, *Illinois, *Multiple-purpose projects, Project planning, Administrative agencies, *Recreation, Water supply, Water management (Applied), Flood control, Expenditures, Government finance, Government supports, Resource development.

The purpose of the Illinois 'Pure Waters Development Act' is to provide programs for the conservation, development, use and management of the state's water resources. The Pure Waters Board is empowered to finance programs with funds derived from the sale of bonds pursuant to the 'Pure Waters Development Bond Act.' In Article 2 of the Act, the Pure Waters Board is empowered to match local appropriations in order to complete projects conforming to the comprehensive statewide outdoor recreation plan. It is provided that project priorities be based on the multiple use concept of providing water management along with recreation utilization. Article 3 of the Act empowers the Board to assist in financing local pollution control projects, including sewage treatment facilities. Articles 4 and 5 allow the Board to assist in financing local water supply facilities and state wide flood control projects. In Article 6 the Board is empowered to finance land acquisition for existing state agencies and the construction and development of state water resources projects by existing state agencies. (Pfeiffer-Fla)
W69-01311

AN ACT TO AMEND SECS 6111.01, 6111.03, AND 6111.31 OF THE REVISED CODE TO EXTEND TAX EXEMPTIONS FOR INDUSTRIAL WATER POLLUTION CONTROL FACILITIES.
State of Ohio, Columbus.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01312

CAUSEY V GRAY)BOUNDARY DISPUTE BETWEEN RIPARIAN OWNERS(.

243 A 2d 575-585 (Md 1968).

Descriptors: Riparian rights, *Boundaries (Property), *Riparian owners, Maryland, Judicial decisions, *Landfills, Accretion, *Equitable apportionment, Jurisdiction, Water law, Boundary disputes, Legislation, Relative rights, Remedies, Rivers.

This action involved a boundary dispute between riparian owners. The parties were adjoining owners of riparian land on the Rhode River. The area in front of both parties' riparian land had been filled in. Plaintiff placed a retaining wall and pier along the water's edge. The boundary in dispute was the line from the water's edge to the end of the boundary between plaintiff's and defendant's fast land. Plaintiff sought a declaratory judgement that he was owner of certain land along the boundary. Defendant demurred to plaintiff's complaint on the grounds that plaintiff had an adequate remedy at law in trespass. The court overruled the demurrer, saying thatequitable apportionment of riparian rights could not be obtained in a court of law. The court reviewed statutory changes in the common law of riparian rights in Maryland. (Kirkconnell-Fla)
W69-01344

LANE V MCEACHERN)TITLE TO LAND BETWEEN HIGH AND LOW WATER MARK(.
162 S E 2d 174-176 (S C 1968).

Descriptors: *South Carolina, High water mark, Low water mark, Rice, Judicial decisions, Navigable waters, *Ownership of beds, Swamps, Marshes, Boundaries (Property), Water law, Banks, Navigable rivers, Fresh Water marshes.
Identifiers: *Patents (Land), *Grants (Land).

This was an action for a declaratory judgment as to ownership of land claimed by plaintiff and the State of South Carolina. The land in question is situated on the east side of the Edisto River, a fresh-water navigable river affected by the tide. The land in its natural state was fresh-water river swamp adjacent to the river lying between the mean high and low water marks. The land has been enclosed by banks and used as a rice field since 1794. Plaintiff traces his title to a grant from King George II in 1734. This grant described the land, but made no mention of the low water mark. The State now asserts title to the land below the mean highwater mark. The court held that no justicable issue existed. The state admitted that the described land was in fact granted to plaintiff's predecessor by King George II, and hence the rule of construction that such grants extend only to the highwater mark did not apply. The court further held that since plaintiff had good title to the land, he had a right to maintain the banks around the land. (Kirkconnell-Fla)
W69-01347

SEACOAST WATER COMM'N V CITY OF PORTSMOUTH)RIGHT OF MUNICIPALITY TO WATER SUPPLY(.

203 A 2d 649-656 (N H 1964).

Descriptors: *Eminent domain, Federal Government, Cities, Municipal water, *Water contracts, *Water rights, Prior appropriation, Condemnation, Utilities, Dams, Reservoirs, New Hampshire, Judicial decisions.

The Federal Government attained through power of eminent domain land located in the city of Portsmouth. The water rights of the city were located within this area. In consideration for the city giving up its chief source of water supply, the Government promised to furnish a replacement supply of like quantity and quality. To fulfill the promise the Government deeded to Portsmouth its rights, title, and interest in Bellamy Dam and Reservoir. The plaintiffs in this action alleged that the city of Portsmouth had no appropriative, statutory, or preemptive rights to the water in the Bellamy River project. They further alleged that the city of Portsmouth, and the U S A, as its agent, were depriving plaintiffs of rights and interests in the water. The Supreme Court of New Hampshire tended that the city had the right and power to acquire the water rights in dispute. The rights were received as consideration for giving up their former supply. Also, it is lawful for a municipality to own land in another community for the purpose of a water supply. (Harriett-Fla)
W69-01348

UNITED STATES V 50 FOOT RIGHT OF WAY)COMPENSATION FOR RIGHT OF WAY OVER SUBMERGED LAND(.
337 F 2d 956 (3 CCA 1964).

Descriptors: *Judicial decisions, United States, *Eminent domain, Condemnation, Right-of-way, Legal aspects, Riparian rights, *Beds, Ownership of beds, Federal government, Condemnation value, *Compensation.

The United States brought a proceeding to condemn a fifty-foot right-of-way across a riparian owner's (Bergen Point Iron Works) land above the highwater mark and across such owner's submerged land under Newark Bay. The U S District Court allowed compensation only for the right-of-way across the upland and denied any compensation for use of the submerged land or interference with Bergen Point's access thereto. On appeal, the Third Circuit Court of Appeals held that where a private owner holds title to submerged lands, the United States could condemn a portion thereof without paying compensation only where it was an aid to navigation or necessary to its control. In this case, the mere running of a pipeline over submerged land could not be considered an aid to navigation, and the United States was required to pay just compensation for the use of Bergen Point's submerged land and the interference with its access thereto. (R. F. Williams-Fla)
W69-01351

BURKHART V CITY OF FT LAUDERDALE)RIPARIAN RIGHTS -- INGRESS AND EGRESS(.
168 So 2d 65-70 (Fla 1964).

Descriptors: *Public rights, Judicial decisions, *Florida, Accretions (Legal aspects), *Riparian rights, Easements, Boundaries (Property), Local government, Navigable waters, Riparian land, Relative rights.
Identifiers: *Street easements, Plats.

This was an action by landowners to have themselves declared owners of certain accretions in New River Sound, a navigable body of water in Broward County, Florida. On the original subdivision plat a street easement ran along the water's edge, but the plat specifically reserved to owners of lots along the street riparian rights in the waters of New River Sound. The court determined that at the time of the plat, no land existed between the street easement and the water's edge. The question was whether the accretions in front of petitioners' lots belonged to petitioners, or were a part of the street easement. This court held that due to the specific reservation of riparian rights to lot owners in the plat, title in fee to the accretions was in petitioners', subject to the public right of ingress and egress to the water from the street. The court said the intent of the dedicator controls. (Kirkconnell-Fla)
W69-01353

TAPOCO, INC V PETERSON)PUBLIC RIGHT TO NAVIGABLE ARTIFICIAL LAKES(.

373 S W 2d 605-609 (Tenn 1963).

Descriptors: Tennessee, *Hydroelectric project licensing, Navigable waters, Riparian land, Artificial watercourses, Lakes, Riparian rights, *Ownership of beds, *Recreation, *Boats, Remedies.
Identifiers: *Houseboats.

Plaintiff public service corporation brought suits against defendant owners of houseboats to require the removal of said houseboats from a lake. The lake was the artificial result of plaintiff's construction of a dam across a navigable stream. The lake covered riparian land held in fee by plaintiff. The court held that land, which in its natural state was not covered by any navigable body of water when granted, retains its character of private property when by force thereafter extended artificially, it becomes submerged by a navigable body of water. Therefore, defendants had no right to moor their houseboats. Dicta indicates that while the artificial lake was available for public recreation under the license granted plaintiff by the Federal Power Commission, defendants' houseboats interfered with fishing, boating, and skiing, and should be banned. (Crabtree-Fla)
W69-01354

MOUNTAIN SPRINGS ASS'N V WILSON)EASEMENT OF USE AND ENJOYMENT OF STREAM(.

81 N J Super 564 196 A 2d 270-278 (1963).

Descriptors: *Easements, Right-of-way, Lakes, Streams, Ownership of beds, Riparian land, *Community development, *Public rights, *Recreation, Relative rights, Zoning, New Jersey.
Identifiers: *Covenants.

An association of property owners brought action against grantees of a member of the association for construction and determination of rights and liabilities under certain covenants and restrictions contained in the deeds. The relevant portion of the deeds granted an easement for use and enjoyment of a lake and stream owned by the association. The court held, that since the easement was in common with other property owners, the association could not require grantees to contribute to the association for maintenance of the lake and stream nor could the association impose rules and regulations on the grantees in their use of facilities granted under the easement. (Crabtree-Fla)
W69-01356

TOWN OF MOULTONBORO V BISSONNETTE)BOATHOUSE ON PUBLIC RIPARIAN LAND(.

196 A 2d 703-706 (N H 1963).

Descriptors: New Hampshire, *Boat-launching ramps, Ownership of beds, *Prescriptive rights, Riparian land, Riparian waters, Easements, Leases, *Public lands, Navigable waters, Judicial decisions.
Identifiers: *Boathouses, Public Trust Doctrine.

This was an action by a town to restrain defendant from maintaining a boathouse in waters of a lake directly in front of plaintiff's property on the shore of the lake. Held, inter alia, that where the town claimed title to the landing place by virtue of its charter of 1763, and a vote of town meeting in 1818 appointed a committee to look after the landing place, and since the town had exercised dominion over the landing place by various leases executed in 1929 and had attempted to prevent defendant from rebuilding his boathouse, that the town had standing to sue, and had a valid title in fee. Inasmuch as the town's right to access to and from the landing place would be adversely affected by defendant's boathouse, and injunction against defendant was proper. (Crabtree-Fla)
W69-01357

COUNTY OF SARASOTA V NEVILLE)FILL IN NAVIGABLE FLORIDA WATERS(.

158 So 2d 533-534 (Fla DCA 1963)

Descriptors: *Judicial decisions, *Florida, Statutes, Riparian land, Permits, Remedies, *Bulkhead lines, Dredging, *Local governments.
Identifiers: Injunction, Fill permits.

In a per curiam decision the District Court of Appeals on interlocutory appeal held that the Sarasota County Water and Navigation Control Act (Ch. 57-1853, Special Acts 1957, Laws of Florida) made the Sarasota County Water and Navigation Control Authority, as opposed to Sarasota County, the only permitted party plaintiff in a suit to enjoin littoral owners from further adding to their lands or constructing any islands in the bay without obtaining a permit. Chapter 253, Fla. Stat. clearly reflects this legislative intent. Although the Authority is composed of the County Commissioners, the board members as County Commissioners have no rights as plaintiff in the case, and the trial court's order dropping the County as party plaintiff should be affirmed. (MacMillan-Fla)
W69-01358

MILLER V COPPAGE)DROWNING IN DREDGED HOLE IN NAVIGABLE WATER(.

261 N C 430; 135 S E 2d 1-6 (1964).

Descriptors: North Carolina, Judicial decisions, *Drowning, Swimming, *Hazards, Recreation, *Dredging, Excavation, Safety, Navigable waters, Ownership of beds, Riparian rights.

This was a wrongful death action to recover damages for the drowning death of plaintiff's seven year old son in the Neuse River. Defendant's were sued because plaintiff alleged that their dredging operations created a hazard which proximately caused the boy's death. The public used Neuse River for recreation for many years. At the point of the drowning, the river was shallow and safe for non-swimming children. Defendants, who were not riparian owners, excavated a large hole not far from shore and did not post it. It was held that defendant's had no right to dredge in the navigable river, but that there was no evidence of proximate cause, and a non-suit was proper. Plaintiff did not establish that the boy was a non-swimmer or where the body was found. (Crabtree-Fla)
W69-01360

VOLPE V MARINA PARKS, INC)RIPARIAN RIGHTS(.
220 A 2d 525-531 (R I 1966).

Descriptors: *Rhode Island, *Riparian rights, *Boundaries (Property), Boundary disputes, Riparian land, Judicial decisions, Shores, Water law, Relative rights.

This action involves a dispute between two landowners as to riparian rights. Both claim title through a common grantor. A platted street ran along the bay between Long Point and Shell Point. The original plat showed no land between this street and the water. Complaintant claims a right to wharf into the bay in front of his property, which is shown on the plat as bordering on the street. Respondent claims all riparian rights along the bay between Shell Point and Long Point. Respondent's title is derived from a conveyance of 'lots A and B . . . together with all riparian, water, shore, and fishing rights appurtenant thereto . . . 'located between Shell Point and Long Point. The court held that the grantor intended to convey all riparian rights between Shell and Long Points to respondent's predecessor. Upon abandonment of the platted street, complaintant took only to the center of the street, not to the water's edge; hence complaintant had no riparian rights. Title to the property between the street and the water's edge, and the riparian rights thereto, were in the respondent. (Kirkconnell-Fla)
W69-01361

TREUTING V BRIDGE AND PARK COMM'N)VALIDITY OF SALE OF SUBMERGED LANDS(.
199 So 2d 627-634 (Miss 1967).

Descriptors: *Mississippi, Ownership of beds, Navigation, Legal aspects, Judicial decisions, Navigable waters, Landfills, Land forming, Land reclamation.
Identifiers: Obstructions to navigation.

This involved a sale of an island and submerged lands to the Biloxi Bridge and Park Commission by the State of Mississippi for the construction of a development project. This was held to be a valid exercise by the state as trustee of submerged land, since it would not interfere with navigation, would in fact improve navigation, and would have many other beneficial effects. The state's ownership of submerged lands as trustee for the people of the state is not a constitutional doctrine, but rather a common-law doctrine. A state constitutional provision prohibiting the legislature from authorizing permanent obstructions to navigable waters does not prohibit the sale of submerged lands and subsequent filling of these lands because it is directed toward free navigation and has nothing to do with waters not suitable for navigation or the sale of submerged lands. (P. N. Smith-Fla)
W69-01362

U S V 738.75 ACRES)TITLE TO ACCRETED LAND(.

263 F Supp 608-612 (E D Ark 1967).

Descriptors: *Condemnation, Riparian rights, Riparian land, Water law, Legal aspects, Navigable water, *Accretion (Legal aspects).
Identifiers: Adverse possession.

The question in the condemnation action involved the title to riparian land. The land was formed by accretion on the bank of the Arkansas River. The first party claims the land as being an accretion to his property. The second party claims the land by adverse possession. The court held that under Arkansas law, the title to lands formed by accretion vests in the riparian owner. However, the court found that the second party was in actual adverse possession of the property and thereby gained title to it. (Horner-Fla)
W69-01365

ROSE V STATE)DAMAGES FOR DESTRUCTION OF WATER SUPPLY(.

289 N Y S 2d 553 (App Div 1968).

Descriptors: *Judicial decisions, *New York, Salvage value, Market value, Evaluation, Compensation, Appropriation, *Riparian rights, State governments, *Condemnation value, Condemnation, Landfills, Relocation, Water supply, Road construction, Highways, Project feasibility, Interest rate, Legislation.

Claimant owned land with river frontage upon which he operated a crushed stone and ready-mix concrete business. For highway purposes the State of New York permanently appropriated a portion of the river bed, and in so doing destroyed claimants' existing source of water as well as access to the river, and simultaneously placed fill along this portion of the property thus completely separating claimants' property from the river at this point and destroying the riparian previously enjoyed. The trial court awarded claimants $208,615 for permanent appropriation of riparian rights and destruction of the water system, plus $45,000 for temporary interference with and taking of the water supply. When claimant learned that his existing water source was to be destroyed, engineering tests were conducted to determine whether a sufficient water supply could be found elsewhere on or near the property. The court held that no such plan was feasible and that neither reasonable efforts nor expenditures would have prevented or mitigated the destruction of claimants' water supply. The court affirmed the assessment of damages to improvements by market value of each fixtures less its salvage value. One judge dissented. (Smodish-Fla)
W69-01368

THOMPSON V JOINT DRAINAGE DIST NO. 3-1)FINANCING DRAINAGE DISTRICT IMPROVEMENTS(.
43 N W 2d 326-331 (Iowa 1966).

Descriptors: *Assessments, *Drainage districts, Statutes, Laterals, *Iowa, Judicial decisions, Taxes.

This opinion involves an action to cancel levy of assessments for work done on a portion of a drainage district. The Winnelago-Kossuth Joint Drainage District included eleven laterals and several numbered drainage districts. The work in issue was one on lateral eight and Drainage District No. 22. The cost of the work amounted to about 86% of the original cost plus improvements to the area to be assessed. A statute required notice and a hearing to property owner, affected by an assessment if the estimate and cost of repair exceeds fifty percent of the original total cost of the district plus subsequent improvements. The question for resolution on appeal was whether the percentage limitations were to be applied to the entire joint district or only to the lateral and drainage district affected. The Supreme Court of Iowa held that the percentage must apply to the lateral and drainage district affected, since these property owners would pay the whole bill through assessments. Since notice and a hearing were not provided as directed by the statute, the entire assessment was declared void. (Harriett-Fla)
W69-01369

WINIECKE V SCHEURER)RIPARIAN RIGHTS IN ARTIFICIAL CHANNELS(.
Mich App 178, 141 N W 2d 717-719 (1966).

Descriptors: *Channels, *Spoil banks, Riparian land, *Riparian rights, *Littoral proprietorship, Contracts (Legal aspects), Judicial decisions, Michigan, Land use.

The two defendants along with three others were co-owners of a tract of land fronting on a channel they had built. The defendants purported to sell by land sales contract some lots to the plaintiffs. The agreement restricted the vendors from erecting any structure on the land between the lots and the channel. When later the vendors increased the size of the spoil bank while working on the channel, plaintiffs sought injunctive relief to get the spoil bank removed. The trial court decision to deny injunctive relief was affirmed in this opinion. The bases for denial was: (1) that no riparian or littoral rights were involved since plaintiffs knowingly purchased channel lots; (2) the written agreement was not binding since the two defendants did not have authority to sign for the others. (Harriett-Fla)
W69-01370

BOARD OF EDUCATION OF UNION FREE SCHOOL DIST NO 11 V NYQUIST)DETERMINATION OF HIGH WATER MARK(.
274 N Y S 2d 229-235 (Sup Ct Albany County, N Y 1966). 51 Misc 2d 902.

Descriptors: Water law, Legal aspects, Judicial decisions, Boundaries (Property), *High water mark, Tidal waters, *New York.

This case dealt with the determination of the boundary of a school district which was described as being the high water mark on a certain island in the Atlantic Ocean. The court stated that the high water mark as applied to tidal waters generally means the line marked by the periodic flow of the tide, excluding the advance of the water caused by winds, storms and unusual conditions. The court held that there is no valid reason for giving the term high water mark any other meaning when used to describe a boundary of a school district. (Batchelor-Fla)
W69-01371

ARNOLD V ELLIS)INJUNCTION AGAINST RAISING THE LEVEL OF A POND(.
5 Mich App 101; 145 N W 2d 822 (1966).

Descriptors: *Michigan, *Remedies, Legal aspects, Adjudication procedure, *Flooding, *Boundary disputes, Ponds, Administrative agencies, Dams, Dikes.

Plaintiffs brought suit to determine boundary and to enjoin defendants from raising the level of a pond on their land thereby flooding plaintiffs' land to the west making it impassable thus depriving plaintiff's access to their northern fields. The trial court granted the injunction determining that the level of the pond should remain at 786 feet above sea level in accordance with a 1914 government survey. The court found plaintiffs entitled to equitable relief since damages would be inadequate and no great injury would be done defendants since ample electric power could be produced with a lower pond level. Construing defendant's deed the court held that defendant's boundary line was the edge of the pond plus a strip one rod wide with the pond at the 786 foot level. This court affirmed, holding that the trial court had power to set the level of the pond since the same power granted to conservation boards by the Inland Lake Level Act was merely optional and did not confer exclusive jurisdiction on those agencies mentioned. (Kahler-Fla)
W69-01377

AUGUSTA WATER DISTRICT V WHITE)CONDEMNATION POWER OF WATER DISTRICT(.
216 A 2d 661-665 (Me 1966).

Descriptors: *Maine, Legal aspects, Judicial decisions, Public utilities, Public utility districts, *Eminent domain, Regulation, Administrative agencies.

The Augusta Water District, a corporation specially chartered by the Maine Legislation, seeks to have the Public Utilities Commission determine its necessity to take land of the defendants by eminent domain. The Supreme Court held that there were no geographical limitations on the district's eminent domain powers as long as the district could demonstrate the necessity of a particular chosen location for the purpose of supplying pure water to its specified areas. (P. N. Smith-Fla)
W69-01383

BANGOR HYDRO-ELECTRIC POWER CO V FPC)HYDROELECTRIC PROJECT LICENSING(.
355 F 2d 13-14 (1 Cir 1966).

Descriptors: *Federal Power Act, *Hydroelectric Project Licensing, Hydroelectric plants, Water utilization, Federal Government, Water law, Navigable waters, Non-navigable waters, Legal aspects, Electric power, Electric powerplants.

The FPC antedated the petitioners license to operate a hydroelectric project on navigable waters and the petitioner asked the court to review the order. The court held that the petitioner should have applied for the license in 1938 or in the alternative should have filed a declaration of intention applicable to non-navigable waters. Since the petitioner did neither, the FPC was correct in antedating his license. (Horner-Fla)
W69-01384

OPINION OF THE JUSTICES)MINERALS ON SUBMERGED LANDS(.
216 A 2d 656-661 (Me 1966).

Descriptors: *Maine, Riparian rights, *Eminent domain, Legal aspects, Judicial decisions, Legislation, Beds under water, Mining, Mine drainage.

The Maine House of Representatives asked the opinion of the Maine Supreme Court as to the legality of a bill which would permit the state's lessee to construct dams on submerged state land in order to mine the minerals under the land, and would permit the state to take riparian rights of bordering landowners by eminent domain with payment of just compensation for the period during which the tidal estuary is drained. The minerals contained in the submerged lands below the low water mark are held in trust by the state for the people. Since there will be no significant impediment to navigation, the temporary damming and draining is permissible. The state's right to do so is paramount and is not subservient to objections of riparian landowners. The landowners are entitled to just compensation for the interference with their riparian rights, and the bill properly allows this. The operation is still a public use, even though it will be carried out by a lessee who pays royalties to the state. The object is the conversion of the public resources to prevent waste, and this is a means to that end. (P. N. Smith-Fla)
W69-01385

BOTTON V STATE)PUBLIC AND RIPARIAN RIGHTS IN NOW-NAVIGABLE WATERS(.
420 P 2d 352 (1966).

Descriptors: *Riparian rights, *Reasonable use, *Washington, *Access, Riparian land, Lakes, Non-navigable waters, Recreation, Judicial decisions, Relative rights, Public rights, Condemnation, Fishing, Remedies.
Identifiers: *Injunction, Remedies (Legal aspects), Police power, Damage (Legal aspects).

This was an action to enjoin the State of Washington from maintaining a public access area on a non-navigable lake. The state acquired a lot on the lake to provide access for the public for the purposes of recreation and fishing. Members of the public so admitted to the lake repeatedly trespassed on plaintiff's property, littered the lake and its shores, stole plaintiff's property, and otherwise rendered the lake undesirable for private riparian owners. The trial court granted a permanent injunction until the state condemned and paid for the plaintiff's riparian rights which the state's licensees had infringed. This court found that the state's licensees' use of the lake constituted an unreasonable use of the lake by a riparian owner. The state was not

required to condemn plaintiff's riparian rights, but the injunction was granted until such time as the state could come up with a plan to police the public's use of the lake. The case contains a lengthy, general discussion of private riparian rights vis-a-vis public rights in non-navigable rights. (Kirkconnell-Fla)
W69-01388

MAYER V GRUEBER)RIPARIAN RIGHTS IN ARTIFICIAL LAKE(.

138 N W 2d 197-205 (Wis 1965).

Descriptors: *Riparian rights, *Ownership of beds, Lake beds, Lakes, Riparian land, Boundaries (Property), Artificial watercourses, Water law, Legal aspects.
Identifiers: Artificial lakes.

The plaintiff in the action sought an injunction to prevent the defendant from trespassing on the waters of an artificial lake. Originally, a 157 acre tract of land was owned by a gravel company and the lake in question was created when gravel was taken from the land. The company sold a 4 acre parcel of the land to the defendant. The deed described the boundary of the property as being along the bank of the lake. The company thereafter sold the remainder of the tract to the plaintiff. The court noted that presumption exists in favor of ownership of a bed of a natural stream by the owner of the bank but that no such presumption exists where an artificial body of water is concerned. They held that the purchaser of property abutting an artificial lake acquires no rights as a riparian owner by virture of land acquisition alone. Unless the vendor conveys the right to use the lake, the purchaser is precluded from either the right of access or use. (Horner-Fla)
W69-01392

WARD V HARWOOD)TITLE TO ISLANDS IN NAVIGABLE RIVER(.

387 SW 2d 318-321 (Ark 1965).

Descriptors: *Arkansas, *Legislation, *Islands, Accretion, Real property, Navigable waters, State government, Water law, Legal aspects, Riparian land, Riparian rights.

The question involves the construction of two state statutes. The first, passed in 1901, said that all land which forms in navigable waters within the original boundaries of a former owner of land upon the stream shall belong to the former owner. The second, passed in 1917, said that all islands formed in navigable streams belonged to the State and set forth the procedure whereby the land commissioner might have the island surveyed and sold. The court held that the 1917 act did not repeal the 1901 act. It construed the 1917 act as saying, in effect, that in all cases where islands are formed in navigable waters and not within the boundary lines of former owners, then the state may sell the island. (Horner-Fla)
W69-01396

WATER QUALITY AND RESOURCES ALLOCATION BY PRIVATE MARKETS,
Resources for the Future, Inc.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01401

EVALUATION OF THE LEGAL INSTITUTIONS OF DIVERSION, TRANSFER, STORAGE, AND DISTRIBUTION OF WATER IN KENTUCKY,
Kentucky Univ, Lexington.
A. Dan Tarlock.
Research Report 15, Kentucky Water Resources Institute, Lexington Kentucky, 1968. 111 p.

Descriptors: Legislation, Legal aspects, Permits, Water law, Riparian rights, Planning.
Identifiers: Kentucky Water Law, K.R.S. 151.

In 1966 Kentucky enacted a water use regulation statute which makes important modifications in the common law doctrine of riparian rights by authorizing the state to grant permits for the use of water. The permit system is primarily designed to allow the state to gather the information necessary to conduct long range planning studies. However, the permit system can also be used to apportion water among competing users. The report examined the common law of riparian rights to determine how KRS Ch. 151 had modified it and analyzed some of the legal problems which could arise in the administration of the statute. The standards for granting or denying a permit were examined in light of the purpose of Chapter 151. Important common law modifications such as the abolition of the watershed limitation were considered. The procedural rights of applicants and third parties affected by the issuance of a permit were criticized because they do not provide an adequate hearing and notice procedure. The constitutional questions raised by the failure of the Chapter expressly to protect prior vested rights were considered. The report concludes with an examination of some emerging problems caused by the increased use of the state's water for recreation. (Author)
W69-01405

SOME LEGAL PROBLEMS CONCERNING GROUND WATER MANAGEMENT,
Bovay Engineers, Inc, Spokane, Wash.
Thomas R. Walenta.
Symp Amer Water Resour Ass, San Francisco, Calif, Proc Ser No 4, pp 39-48, Nov 1967. 10 p.

Descriptors: *Ground water, *Water laws, Aquifers, Laws, Groundwater recharge, Pollution abatement, Water pollution, Water quality, Riparian rights, Underground water storage.
Identifiers: *Groundwater management, Groundwater mining, Adjudication procedure, Legal aspects, Prior appropriation.

The many problems connected with water and related land resources have been generated by an expanding population, with its consequent needs for water far beyond any before contemplated. Some of these problems include: (1) the need to classify all ground waters as public waters subject to regulation and control by the state; (2) determination of critical ground-water areas; (3) protection of the prior appropriator in extracting ground water from the basin or aquifer; (4) artificial recharge of ground-water areas and their use for storage purposes; (5) control and abatement of ground-water pollution and need for water quality programs; and (6) cooperation between state and Federal agencies in developing all water resources, a new form of creative Federalism. (USBR)
W69-01417

CLEAN UP OF LAKE MICHIGAN.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-01500

CHICAGO ACTS TO ATTACK COMBINED SEWER PROBLEM.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01512

200 POLLUTERS GET THE WORD EARLY.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01513

6F. Nonstructural Alternatives

IOWA NATURAL RESOURCES COUNCIL V VAN ZEE)FLOOD PLAIN ZONING(.

158 N W 2d 111 (1968).

Descriptors: *Iowa, *Flood plains, Legislation, Guiding codes, *Flood plain zoning, Administrative agencies, *Remedies, Permits, Construction, Eminent domain.

The Iowa Natural Resources Council instituted an action for mandatory injunctive relief as to structures constructed without a permit on dependants' land within a flood plain and also for injunction as to further construction. The Iowa Supreme Court construed Chapter 455A of the 1966 Code as allowing mandatory injunction for the removal of existing buildings only where they could be shown to constitute nuisances within the definition of the statute. Injunction relief as to construction in progress or future construction could be obtained merely by showing that it was within a flood plain and proceeding without a permit. Alternatively the statute allowed removal of objectionable structures not amounting to nuisances by eminent domain proceedings. The court upheld the constutionality of the statute since the collective benefit therefrom outweighed any specific restraint. Requiring a permit was deemed no invasion of private property rights. The dissent contended that the statute allowed mandatory injunction for removal of structures constructed without a permit after the enactment of the statute since to deny it is to deny the only effective remedy for an unlawful act. (Kahle-Fla)
W69-01343

JOHNSTON V STAPLES)LEGALITY O WATERSHED CONSERVANCY DISTRICT(.
408 S W 2d 206 (Ky Ct App 1966).

Descriptors: *Kentucky, *Watershed management, Legislation, State governments, Federal government, Remedies, Adjudication procedure, Taxe *Drainage districts.

Plaintiffs challenged the validity of the creation o watershed conservancy district and sought prevent an exploratory survey to determine fea bility of creating such a district. After defendan moved for summary judgment plaintiffs offered amend their complaint. The Circuit Court refus the amendment and plaintiffs appealed. T amended complaint alleged that since much of t land within the district belonged to the fede government and was not taxable as the statu creating the district provided, the district was legally constituted and not authorized by law. T court construed the statute to mean only that p perty subject to taxation would be taxed and that all property within the district would be tax Furthermore, since the United States Governm had not complained of the inclusion of its l within the district, plaintiffs could not do so. abuse of discretion being found in rejecting pla tiff's amended complaint, the lower cou judgment was affirmed. (Kahle-Fla)
W69-01378

SOME ECONOMIC ASPECTS OF LAND REGULATION,
Ford Foundation, Washington, D.C., Econo Development and Administration Program.
William C. Pendleton.
In Factors in the Farmland Market, University o linois College of Agriculture, Special Publica No. 8, 1965, 14 p, 10 ref.

Descriptors: Land classification, Land deve ment, Land use, *Land management, Flood pro tion, Administrative agencies, *Non-structura ternatives, *Flood plain zoning, Project plann Regulations, Economic evaluation, Local gov ments, Decision making.

Identifiers: Policy regulations, Land-use planning.

Land-use regulations relevant to local interests such as zoning, subdivision controls and building codes are analyzed. It is suggested that non-economic considerations may outweigh the economic ones in deciding the best land use. Four types of arguments for the regulation of flood plains are discussed and criticized. These arguments state that controls of flood plain lands are necessary to protect other land owners or users, the land user against himself, public agencies, and future generations against present land users. Only the first of these is supported. The next is rejected because of its interference with individual freedom, and the third due to the relatively low cost incurred by relief, emergency evacuation, etc., especially when a flood insurance program is used. In order to benefit from the use of the flood plain two approaches are considered; imposing of land use regulations which will protect third parties; and balancing social cost and private gain. While a zoning agency is suggested, it is emphasized that the private sector can make many decisions for itself. Public intervention is considered justifiable in forcing individuals to act without anticipating relief, pay a pre-payment levy for relief, or carry flood insurance. (Richmond-Chicago)
W69-01403

6G. Ecologic Impact of Water Development

PARTITIONING OF THE ESTUARINE ENVIRONMENT OF TWO SPECIES OF CANCER,
Rhode Island University, Graduate School of Oceanography.
H. P. Jeffries.
PHS Grants WP-0002 and WP-00858, Ecology, Vol 47, No 3, pp 477-481, 1966. 5 p, 5 fig, 2 tab, 20 ref.

Descriptors: Distribution, *Crabs, *Population, Chemical analysis, *Spatial distribution, Fish physiology, Temporal distribution, Bibliographies.
Identifiers: *Rock crabs.

There is little mixing of Cancer irroratus and Cancer borealis populations in Narragansett Bay, R.I. Cancer irroratus is found on sand, and C. borealis occurs in areas of coarse gravel and mixed rocky debris. The morphology, walking ability and serum of these crabs were examined to explain their separation in the bay. (S. Mayer-FWPCA)
W69-01241

INTERNAL CONDITIONS OF A DIMINISHING BLUE CRAB POPULATION)CALLINECTES SAPIDUS(,
Rhode Island University, Graduate School of Oceanography.
H. P. Jeffries.
PHS Grants WP-00023 and WP-00858, Chesapeake Science, Vol 7, No 3, pp 164-170, 1966. 7 p, 2 fig, 1 tab, 19 ref.

Descriptors: *Crabs, Population, Fish management, Fish physiology, Chemical analysis, Bibliographies.
Identifiers: *Blue crabs.

Abundance of the blue crab, Callinectes sapidus, in Rhode Island estuaries has decreased during the last 30 years. A commercial fishery once existed in areas where the blue crab is no longer found. Composition of the plasma and muscle was studied to see if abnormalities could be recognized. Mean concentrations of total sugars, protein, non-protein nitrogen, phosphate, and chloride did not differ in crabs from two contrasting lagoons; the mean concentrations of lipids and total nitrogen were also independent of the populations's habitat. The concentration of sugars was atypically low compared with reports on crabs from North Carolina. In the plasma, total sugar concentration was directly related to its conductivity; the concentrations of non-protein nitrogen and phosphate were inversely related to chlorinity. Groups of such correlated tests have predictive value and, when further elaborated, they might be applied to the management of the fishery. This investigation was supported by Public Health Service grants WP-00023 and WP-00858. (S. Mayer-FWPCA)
W69-01242

AN INVENTORY AND STUDY OF BEAVER IMPOUNDED WATER IN MISSISSIPPI,
Mississippi State Univ., State College.
Dale H. Arner, James Baker, and David Wesley.
Water Resour Res Inst, July 1967. 49 p, 22 fig, 13 ref. OWRR Project A-009-Miss.

Descriptors: *Beavers, *Ponds, Surface waters, Limnology, Ecology, Fish populations, Trees, Mississippi, Soil chemistry, Water supply, Water table.
Identifiers: *Beaver ponds.

A survey in Miss. has revealed that there are 956 beaver ponds containing 23,673 acres of water. Limnological and ecological studies of randomly selected beaver ponds and feeder streams showed that 58.1% of these ponds had areas suitable for growing duck food. The dry weight of aquatic invertebrates was higher in beaver ponds than in feeder streams. Soil chemistry studies showed a buildup in beaver ponds of phosphate, potassium, and organic matter greater than in feeder streams. Fish population studies indicated there were more game fish in beaver ponds than in feeder streams. Tree damage caused by beavers was estimated at 9.6 cords per acre. A sportsmen and landowners survey in Miss. showed that there was significant interest in developing and leasing beaver ponds for recreational use.
W69-01248

INTERPRETING THE 1951 RIVERS POLLUTION PREVENTION ACT,
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-01527

07. RESOURCES DATA

7A. Network Design

GOVERNOR AND COUNCIL TO REPRESENT COMMONWEALTH IN U S GOVERNMENT SURVEYS.
State of Massachusetts, Boston.

Mass Ann Laws Ch 6, Sec 9 (1967). 1 p.

Descriptors: *Massachusetts, *Legislation, *Federal government, *Surveys, Harbors, Rivers, Shores, State governments.

The governor and his council are directed to cooperate in behalf of the commonwealth in all scientific surveys made by the U S government of harbors, rivers, shores or waters within the commonwealth. They are further directed to represent the commonwealth in relation to such surveys and to protect its interests. (Watson-Fla)
W69-01294

ASCE'S URBAN WATER STUDIES.
ASCE - San Eng Div, Newsletter, p 1, July 1968.

Descriptors: *Design, *Storm drainage, Data collections, Instrumentation, *Rainfall-runoff relationships, *Water quality, Model studies.
Identifiers: *Urban drainage, *Urban hydrology, Storage tanks.

ASCE has initiated a study program on urban hydrology consisting of two projects. 'An Analysis of National Basic Information Needs in Urban Hydrology' is a study to determine the kinds of data needed to improve the design of an urban area's storm drainage facilities; needs for data-collecting instrumentation; and appraisal of the types of networks necessary to collect adequate data. 'A Systematic Study and Development of Long-Range Programs of Urban Water Resources Research' aims to furnish guidelines for initiating and expanding a long-range study on urban water problems; conduct a state-of-the-art study of simulation methods potentially usable for analyzing urban rainfall-runoff-quality processes; and study the requirements for assessment of drainage damage and the use of storage schemes. The non-hydrologic aspects of urban water-resources research needs will also be investigated.
W69-01556

7B. Data Acquisition

INDUCED ELECTRICAL POLARIZATION AND GROUNDWATER,
California University, Berkeley.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-01235

A SINGLE-WELL METHOD FOR DETERMINING THE DIRECTION AND VELOCITY OF FLOW OF UNDERGROUND WATERS--RESULTS OF IN-THE-FIELD INVESTIGATIONS,
Institute of Nuclear Technology and Hydrogeological Enterprise, Cracow, Poland.
Boguslawa Turkowa, Krzysztof Czauderna, and Jan Tyrala.
Atomic Energy Comm Translation 6810, 6811, pp 55-61, 1968. Translated from Nukleonika, Vol 12, No 1-2, 1967.

Descriptors: *Groundwater flow, *Radioactive isotopes, Wells, Ground water, *Radiation measurement, Piezometers, Water table, Permeability, *Tracers, Infiltration.
Identifiers: Radiometry, Flow patterns, Flow rate, *Dilution method, Flow characteristics, Iodine isotopes, Subsurface flow.

A single-well method is presented to determine velocity and direction of underground waterflow and results of field tests. Flow measurements require that a charge of radioactive tracer of known concentration be placed in a water-filled hole. The concentration of the tracer is measured by radiometric in-hole probes as the water flows from the hole, and is proportional to the flow. Tracer-laden water moving across the drill hole and escaping through the side of the hole will build up radioactivity from the deposited tracer. The flow-direction probe is surrounded by a shield with one open slot through which radioactivity is admitted. The probe is rotated in the hole and the direction of maximum radioactivity indicates the sector on the wall of the hole where water is escaping. Measurements were made in four drill holes to test different subsurface conditions. Comparison of results shows agreement among certain tests and lack of agreement among others. The conclusion was that the investigations will supply material for further study and planning of additional tests. (USBR)
W69-01411

PERFORMANCE MONITORING OF A DEEP COFFERDAM IN SENSITIVE CLAY,
James F MacLaren Ltd, Toronto, Canada.
N. D. Pappas, and D. P. Sexsmith.
Can Geotech J, Vol 5, No 2, pp 80-94, May 1968. 15 p, 7 fig, 1 tab.

Descriptors: *Cofferdams, *Clays, *Sheet piling, Foreign construction, *Soil pressures, Strain gages, *Instrumentation, Strain measurement, Ice pressures, Deflection, Struts, Liquid limits, Soil physical properties, Lateral forces, Prestressing, Excavation.
Identifiers: Soil-structure interaction, Steel piles, Canada, Foreign research.

U. OF I. URBANA - CHAMPAIGN

A deep, steel sheet-piled, figure-eight cofferdam with circular steel wales was installed as a temporary substructure during construction of the City of Ottawa Pollution Control Center Project. The soil profile consisted of 90 ft of a very sensitive stiff clay layer overlying 10 ft of till over the bedrock. Typical soil properties are given, the most significant being that the moisture content of the clay at lower levels is above the liquid limit. A lateral pressure of 4000 lb/sq ft applied uniformly from top to bottom was selected for the cofferdam. An attempt was made to measure axial deformation of the struts and lateral deflection of the sheet piling. Whittemore mechanical strain gages were used to measure the axial deflection of the 24WF100 struts. Duplicate readings within three to four scale divisions (1 division equals a stress increment of 150 lb/sq in.) were possible after several months. Wilson Slope Indicator gages were unsuccessful in indicating lateral deflection of the steel piling. Plots of soil pressure inferred from strain measurements vs death for various levels of excavation are given. Excessive pressure created by the ice lens in the exposed sheeting was detected by the instrumentation. (USBR)
W69-01413

SONAR TOOL SURVEYS UNDERGROUND CAVITIES,
Prakla Gmbh, Hannover, W. Germany.
For primary bibliographic entry see Field 08E.
For abstract, see .
W69-01449

THE DEVELOPMENT OF SEISMIC OBSERVATIONS AND APPARATUS IN THE USSR,
E. S. Borisevich, D. P. Kirnos, and D. A. Kharin.
Phys Solid Earth, No 11, pp 728-734, Nov 1967. 7 p, 2 fig, 31 ref.

Descriptors: *Seismology, *Earthquakes, *Seismographs, Seismic waves, Tsunamies, Geophysics, Reviews, Instrumentation, Recording systems, Data processing systems, Seismic design, Oscillographs, Bibliographies, Measuring instruments.
Identifiers: Epicenters, Foreign research, Earthquake focus, USSR, Earthquake zones.

The improvement of seismic instrumentation and capabilities in the USSR in the last 50 yr is reviewed. Earthquake studies in Russia began in the second half of the 19th century, and a Permanent Central Seismic Commission was formed in 1900. Eighteen seismic stations had been established and 4000 earthquakes recorded by 1908. Epicenters could not be located because of the unsatisfactory quality of the equipment and seismograms. Seismology in Russia was improved from 1902-1906 by Academician B B Golitsyn and associates. Under the Soviet government the range of observations and the arsenal of instrumental equipment required have increased greatly in quality and quantity and have contributed to the present high level of seismology in Russia. The development of tsunami warning stations in the Kuril Islands is of particular interest. These are arranged so that the location of an earthquake and its magnitude can be quickly determined and, in case of tsunami danger, warnings can be sent to settlements that might be threatened. (USBR)
W69-01461

DETENTION AND PREVENTION OF FOUNDATION UPLIFT FROM PRESSURE GROUTING,
Resources Agency, Sacramento, Calif.
For primary bibliographic entry see Field 08F.
For abstract, see
W69-01463

ENVIRONMENTAL ANALYSIS AND REMOTE SENSING,
Cold Regions Research and Engineering Laboratory, Hanover, N. H.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-01467

LABORATORY EVALUATION OF SELECTED RADIOISOTOPES AS GROUND-WATER TRACERS,
Texas A and M Univ, College Station, Texas.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-01491

08. ENGINEERING WORKS

8A. Structures

SEC 137 RAISING WATER SO AS TO INJURE MILL--SEC 138 INJURY TO DAM, RESERVOIR, ETC.
State of Massachusetts, Boston.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01290

ECONOMIC DERIVATION OF RESERVOIR OPERATING RULES,
Kentucky Univ, Lexington, Civil Eng Dept.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01406

STRESSES AGAINST UNDERGROUND STRUCTURAL CYLINDERS,
Massachusetts Institute of Technology, Cambridge. Kaare Hoeg.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 94, No SM4, pp 833-858, July 1968. 26 p, 14 fig, 4 tab, 16 ref, 3 append.

Descriptors: Stress distribution, Culverts, *Underground structures, Pipes, Cylindrical shells, *Soil pressures, Lateral forces, Flexibility, Bending moments, Elastic theory, Sands, Flexible tubing, Soil mechanics, Mathematical analysis, Structural behavior, Laboratory tests, *Pressure distribution, Models, Bibliographies.
Identifiers: *Soil-structure interaction, Pipe bedding, Plane strain, Pipe tests.

The magnitude and distribution of static normal soil stresses against underground structural cylinders are studied. Results of laboratory tests on 4.5-in.-dia cylinders buried in dry sand are presented. Test cylinders were split into longitudinal segments, and the force acting on each 30-deg arc of the soil-structure interface was measured. The experimental program included buried cylinders varying from almost perfectly rigid to flexible, encased in sheets of foam rubber. Analytical solutions for contact pressures and deformations are expressed by two nondimensional stiffness parameters relating flexibility and compressibility of the structural cylinder to the compressibility of a solid soil cylinder. For a perfectly rigid cylinder buried deeper than one cylinder diameter, the crown pressure is approximately 1.5 times the applied vertical pressure and the side pressure is 0.25 times the applied vertical pressure, independent of the soil modulus. The crown pressure will be approximately 0.7 times applied vertical pressure and the side pressure will be approximately 0.9 times applied vertical pressure after the flexibility ratio has exceeded a certain magnitude. (USBR)
W69-01421

COMPARISON OF ANALYTICAL AND STRUCTURAL BEHAVIOR RESULTS FOR FLAMING GORGE DAM.
Bureau of Reclamation, Denver, Colo.

Bur Reclam Res Rep No 14, 1968. 21p, 12 fig, 4 tab, 11 ref.

Descriptors: *Arch dams, *Concrete dams, Stress analysis, Deflection, Dam design, Instrumentation, Strain measurement, Computers, Temperature, Measuring instruments, Thermal stress, Data collection systems, Creep, *Structural behavior, Plumblines, Elasticity modulus, Dams.
Identifiers: Flaming Gorge Dam (Utah), Utah, *Trial-load method.

Efficacy of the trial-load method and reliability of assumptions used in the design and analysis of concrete arch dams can best be demonstrated by comparing analytical results with deflections and stresses from structural behavior measurements for an existing dam. Instruments that indicate length change, temperature, and deflection were installed in Flaming Gorge Dam; readings were recorded at scheduled intervals. An electronic computer was used to reduce the data to stresses, temperatures, and deflections. Stress and deflection changes were determined for 2 incremental loadings. Changes from Oct 9, 1963, to Mar 26, 1964, show the effects of seasonal temperature variation. Reservoir water and tailwater levels remained essentially constant during this period. Changes from Mar 26, 1964, to Mar 6, 1966, are the effects of a rise in reservoir water level. Average concrete temperatures were approximately the same for both dates; the tailwater level remained constant over the entire period. Trial-load analyses were made for the same incremental loadings, using an electronic computer. Comparisons of stress and deflection changes for each loading increment are presented. Agreement between analytical studies by the trial-load method and structural behavior results is very close. (USBR)
W69-01441

DESIGN STUDIES OF IDIKKI ARCH DAM,
Central Water and Power Commission, India.
L. V. Kunar, and C. S. Jain.
Indian J Power River Val Develop, Vol 18, No 4, pp 136-148, Apr 1968. 10 p, 5 fig, 3 photo, 5 tab.

Descriptors: *Arch dams, Concrete dams, Underground powerplants, Model tests, Elastic deformation, Mass concrete, Tunnels, *Dam design, Joints, Dam foundations, Mapping, Aerial photography, Foreign projects, Geologic investigations, Preliminary investigations, Seismic investigations, Design criteria, Structural models, Gneisses.
Identifiers: In situ tests, India, *Idikki Dam (India).

The Idikki Hydroelectric Project in the Periyar Valley of Kerala State, India, contains a large reservoir formed by 3 dams. Water will be diverted into an adjacent basin by a 6480-ft power tunnel, 2 pressure shafts 3300 ft long, and the tailrace tunnel. There is an underground powerplant with 6 units of 130 MW. With an average head of 2181 ft and a continuous draft of 1440 cu ft/sec, the units can generate 780 MW of power at about a 30% load factor. A survey for locating the tunnel and penstocks was made by aerial photography. The foundation investigation included tests on cores and in situ dynamic tests by ultrasonic and seismic methods. The foundation at the Idikki damsite is composed of tightly foliated gneisses with bands of charnokites and is traversed by innumerable joints. Bureau of Reclamation design criteria were generally used for the arch dam. The preliminary design analysis used the crown cantilever method in which the total load was assumed to be distributed between the cantilever and arches. Structural model tests considering only the effect of water load were performed in the CWPRS Laboratory, Poona. (USBR)
W69-01442

SURVEY CONTROL FOR CONCRETE DAM CONSTRUCTION,
Bureau of Reclamation, Montrose, Colo.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01457

8B. Hydraulics

OPTIMUM PENSTOCK DIAMETER FOR HYDROELECTRIC POWERPLANTS AND PUMPING PLANTS,
California State Department of Water Resources, Sacramento.

For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01431

8C. Hydraulic Machinery

CONTRIBUTION TO THE OPTIMIZATION OF SYSTEM OPERATION BY THE CHOICE OF SUITABLE METHODS OF CALCULATION FOR TRANSIENT STABILITY,
Dresden Technical Univ, Germany.
K. D. Wessnigk, H. Koettnitz, and H. Schulze.
Int Conf Large High Tension Elec Syst, Paris, France, June 1968. Pap 32-11, 9 p, 7 ref, 7 append.

Descriptors: *Transients, Operations, Calculations, Computers, Errors, Electric power, Transmission (Electrical), Optimum use, *Power system operations, Electrical networks, Voltage regulators, Electric potential, Faults (Electrical), *Electrical stability, Disturbances.
Identifiers: Liapunov Theorem, *System stability (Elect), Synchronous machines, Foreign research, Germany, Switching surges.

The behavior of faults must be considered when planning a system, determining optimum operation, or optimizing a power system by process-control. Transient stability loss is a serious disturbance that can be avoided through proper interpretation of previous calculations and corresponding corrective action. Digital, hybrid, and analog computers can be used for these calculations. Important factors in transient stability calculations include saliency effects, voltage and power regulation, damping, transient characteristic curves of the load, resynchronization, and in special cases the probability for synchronous operation of single units. Reasons for transient instability include faults, switching loads, and network changes. Transient stability is treated by calculating the steady state and initial values, setting up equations of motion of machines, and solving these equations. Methods of solution are discussed. Limitations of computer application and influencing factors are considered. For each calculation, the main points to be considered are given, independently from the method used. (USBR)
W69-01414

EFFECT OF INCREASING THE GENERATING UNIT SIZE ON SYSTEM INTERCONNECTION TIE LINES,
Hungarian Power Pool; Office for Power Station and Network Design, Budapest, Hungary.
A. O. Kerenyi, F. Ronkay, and J. Peto.
Int Conf Large High Tension Elec Syst, Paris, France, June 1968. Pap 32-06, 14 p, 7 fig, 5 tab, 2 ref, append.

Descriptors: *Power system operations, Electric power, Electric power costs, *Transmission (Electrical), Electrical networks, Benefits, Power O+M, Probability, Electric generators, Computation, Economics, Electric power demand, Electric power production.
Identifiers: Spinning reserve, *Tie lines, Interties, Hungary, Foreign research, Outages, *Interconnected systems, Gaussian distribution.

The effect of large-size generating units on the transmission capacity of interconnecting tielines is investigated. The following aspects are considered: (1) benefits to the national economy resulting from the interconnection of systems; (2) transmission capacity of interconnections permitting maximum utilization of economic benefits resulting from intersystem cooperation, (3) the required economical spinning reserve, and (4) the means necessary within the interconnected systems to ensure service continuity. A hypothetical system demonstrated the effects of unit size on the capacity of interconnecting tielines. A static and dynamic method is proposed for determining the benefits of interconnection of power systems, regarding emergency help, economical load dispatching, and establishing a system development policy. The problem of economical spinning reserve is considered, and a survey of measures ensuring service continuity of integrated systems is given. An algorithm is presented for computing the histogram of power exchange between interconnected systems. (USBR)
W69-01416

DETERMINATION OF POWER TRANSFER CAPABILITY OF TRANSMISSION SYSTEMS AND TIE-LINES ON THE OCCURRENCE OF SEVERE DISTURBANCES,
Swedish State Power Board, Stockholm.
A. Olwegard, and P. Langer.
Int Conf Large High Tension Elec Syst, Paris, France, June 1968. Pap 32-04, 10 p, 9 fig, 3 ref.

Descriptors: *Electrical networks, Electrical stability, Transmission lines, Computers, *Transmission (Electrical), *Disturbances, Extra high voltage, Field tests, Computer programming, Hydroelectric power, Stress, Voltage regulators, Electric power, Excitation, Thermal power, *Faults (Electrical), Transients, Electric power failures.
Identifiers: *Tie lines, *Interconnected systems, *Power system stability, Spinning reserve, Sweden, Foreign research, Power grids.

Loss of large generators or tripping of heavily loaded transmission lines momentarily results in transient stresses on a network that may be less than those occurring after transient line faults with rapid disconnection and autoreclosing. Tripping of generators or lines may set up such severe undamped swings on the system that some synchronous machines will fall out of synchronism and eventually in chain reaction lead to a complete breakdown. Line tripping and loss of large power units may be among the factors most important for stability. The steady state stability after the fault, and the transition from transient to steady state conditions become decisive factors. Investigations are important to determine how the transmission capacity is affected by such factors as design of power-frequency regulation equipment, load characteristics, and voltage regulation. Two methods of calculating the dynamic behavior of the system are compared with field tests of the transmission capacity of a tieline connecting a Norwegian 130-kv network with the Swedish network. (USBR)
W69-01418

OPTIMISATION IN THE USE OF THE MEANS OF PRODUCTION AND TRANSMISSION,
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01422

PLANNING OF 735 KV EXTENSION TO HYDRO-QUEBEC SYSTEM TO INCORPORATE CHURCHILL FALLS IN 3300 MILE NETWORK,
R. Fournier, D. McGillis, and J. C. Roy.
Int Conf Large High Tension Elec Syst, Paris, France, June 1968. Pap 42-02, 8 p, 6 fig, 1 tab, 9 ref.

Descriptors: *Extra high voltage, Alternating currents, Electric power production, *Transmission lines, Direct currents, Economics, Technology, Transmission (Electrical), Losses, Electric power, Electrical stability, Hydroelectric power, Electric insulation, Foreign construction, Bundled conductors, Extra long distance, Costs, Foreign projects.
Identifiers: Churchill Falls Pwrplt (Canada), Hydro-Quebec (Canada), Switching surges, Performance.

The Churchill Falls Development, located 800 mi northeast of Montreal, will generate 5000 mw and 30 billion kwh of power. Transmission of this power has been studied extensively by Hydro-Quebec. The reliability of ehv a-c transmission is discussed from experiences available after 2 yr operation of the Hydro-Quebec 735-kv network. The possibilities of hvdc transmission are investigated. Application of these 2 technologies to Churchill Falls is made by technical and economic comparisons. Results apply only to the particular problem, but general trends in ehv transmission are indicated. Studies made by Hydro-Quebec in selecting the transmission system from Churchill Falls to Montreal are discussed. The extension of the Hydro-Quebec network to incorporate Churchill Falls presented a choice of extending the use of 735-kv a-c transmission or embarking on hvdc transmission. This paper assesses the possibilities of a-c and d-c transmission; while the analysis concerns Churchill Falls problems, the main objective is to evaluate the future of ehv transmission. (USBR)
W69-01424

INSULATION CO-ORDINATION IN EHV SYSTEMS WITH LOW INSULATION LEVELS -- A SURGE DIVERTER PROBLEM,
B. Thoren.
Inst Eng, Aust, Elec Eng Trans, Vol EE4, No 1, pp 31-36, Mar 1968. 6 p, 7 fig, 2 tab, 10 ref, disc.

Descriptors: *Extra high voltage, *Electric insulation, *Coordination, Lightning, Circuit breakers, Alternating currents, Resistors, Electrical networks, Capacitors, Computers, Electrical equipment, Stress, Foreign countries, Power transformers, *Surges.
Identifiers: *Switching surges, *Surge diverters, *Overvoltage, Basic impulse level, *Protection (Electrical), Sweden, Electrical insulators.

Insulation coordination is a problem in ehv systems with low insulation levels because of the comparatively low insulation withstand strength against switching overvoltages. An application philosophy for surge diverters is outlined, in which a distinction is made between surge diverters used only for protection against lightning overvoltages and those used also for protection against switching overvoltages. The choice of suitable sparkover characteristics and discharge abilities of surge diverters is discussed. A flat sparkover characteristic is desirable when the surge diverter is used for protection against all types of overvoltage. A computer study of the phenomena occurring with line switching shows that a surge diverter with a low sparkover voltage must be able to handle repeated discharges with high energy contents. (USBR)
W69-01426

FUNDAMENTALS OF HVDC INTERRUPTION,
W. Pucher.
Electra--CIGRE, No 5, pp 24-38, June 1968. 15 p, 10 fig, 18 ref.

Descriptors: *Extra high voltage, Energy, *Direct currents, Resistors, Electric currents, Inductance, Magnetic induction, Electric insulation, *Circuit breakers, Faults (Electrical), Electric potential, Dielectrics, Bibliographies, Extra long distance, Capacitance, Rectifiers, Control systems, Capacitors.
Identifiers: *Switching surges, *Overvoltage, Short circuits, Sweden, Foreign research, Switching.

Various switching operations that may be expected when breaking devices are applied to hvdc transmission show 6 typical cases: (1) clearance of faults close to the converter station, (2) clearance of faults at a remote point on the transmission line, (3) interruption of load currents without transmission line, (4) interruption of load currents with transmission line, (5) interruption of load currents on parallel lines, and (6) switching of lines under no-load conditions. The first 5 methods of d-c interruption and their reaction on a circuit breaker are studied, using an equivalent circuit. The sixth method does not present any major problem in d-c interruption. HVDC transmissions now in service are operated in conjunction with special current-control systems, and short-circuit fault currents are limited to values not much in excess of normal load currents. The amount of magnetic energy in the circuit will be about the same for normal load and

short-circuit fault currents. The magnetic energy of the system will increase with higher currents and longer lines; energy released in the breaker will depend on the switching voltage and the type of current control used. (USBR)
W69-01428

STUDY OF OVERHEAD GROUND WIRES FOR DC TRANSMISSION LINES,
Cairo Univ., Giza, Egypt.
Mohamed M. Khalifa.
Inst Elec Electron Eng Trans Power App Syst, Vol PAS-87, No 7, pp 1648-1656, July 1968. 9 p, 7 fig, 2 tab, 1 ref, disc.

Descriptors: *Direct currents, Transmission lines, Interference, Field tests, *Electrical coronas, *Radio interference, Telephones, *Electrical grounding, Laboratory tests, Instrumentation, Measurement, Ionization, Energy losses, Models, Losses, Electric currents, Electrical engineering.
Identifiers: *Overhead ground wire, Bipolar transmission lines, United Arab Republic, Test results, Foreign research, Induced voltage.

Experimental and calculated results are presented of a study on the influence of overhead ground wires on corona losses, radio interference (RI), and telephone interference of d-c lines. Corona losses and RI were measured on a full-scale bipolar test line. Corona losses were measured on laboratory models of monopolar, homopolar, and bipolar lines. Telephone interference levels were obtained by computer. Ground wires cause a considerable increase in corona losses of monopolar and homopolar d-c lines. Two ground wires on a bipolar d-c line cause a significant increase in corona losses only at voltage gradients close to the inception level, and cause a reduction in RI at higher voltages. Insulated ground wires have no significant effect on corona losses on d-c lines, but acquire voltages that may reach a considerable percentage of the line voltage. Ground wires above the high-voltage conductors of d-c lines raise the interference level in adjacent telephone circuits; the effect is slight at locations near line terminals. (USBR)
W69-01432

NEW DEVELOPMENTS IN HIGH-VOLTAGE MINIMUM OIL CIRCUIT BREAKERS,
Micafil Ltd., Zurich, Switzerland.
Urs P. Gugelmann.
Inst Elec Electron Eng Trans Power App Syst, Vol PAS-87, No 7, pp 1613-1622, July 1968. 10 p, 12 fig, 2 tab, 4 ref, disc.

Descriptors: *Circuit breakers, Interrupters, Electric power, Electric currents, Design, *Electrical equipment, Resistors, Field tests, Faults (Electrical), Test procedures, Hydraulic systems, High pressures, Power O and M, Reliability.
Identifiers: Insulating oil, Foreign research, Switzerland, Oerlikon Eng. Co. (Zurich).

A new restrike-free, fast-acting, minimum oil circuit breaker for the 60- to 500-kv range is described. The breaker can be equipped with interrupters for either 40,000 or 60,000 amp, providing a maximum symmetrical interrupting capacity of 50,000 mva. The modular-type breaker is built from self-contained, identical, and interchangeable basic building elements. The breaker is practically noiseless, has vibration-free operation, has a reliable drive precluding any undue action, and is fast and simple to erect and maintain. Arcing time is independent of the interrupted current because of an effective oil injection system. Fully hydraulic operation of the contacts eliminates the use of mechanical transmission and springs. Test results confirm that the breaker's performance exceeds standard requirements; it is insensitive to high rates of recovery voltage. (USBR)
W69-01433

TOKYO'S OUTER LOOP SYSTEM,
Tokyo Electric Power Co., Inc., Japan.
Ichiro Hori.
Energy Int, Vol 5, No 8, pp 12-15, Aug 1968. 4 p, 4 fig, 1 tab.

Descriptors: *Extra high voltage, Electric power, Reliability, Safety, Power system operations, Foreign construction, Distribution, Planning, Electric power demand, Electric power production, Thermal power, Thermal powerplants, Coordination, *Transmission (Electrical), Pumped storage, Hydroelectric power, Transmission lines.
Identifiers: Japan, *Electrical design, *Interconnected systems, Load centers, Underground cables, Fossil fuels.

This paper discusses progress being made by the Tokyo Electric Power Co. for modernizing power supply facilities in Tokyo to meet the predicted expansion in consumer demand. Since 1960, the 275-kv outer loop system has been strengthened by making it a double-circuit system functioning as a ring surrounding the load center in Tokyo. The voltage of this system will be raised to 500-kv operation to match voltage on the trunk lines as their voltages are increased to meet demand. The ehv system will be extended into the center of Tokyo through 275-kv underground cables. A 300-mw d-c frequency converter station has been installed, making it possible to interconnect the 50-cycle Nagoya loop with the 60-cycle Tokyo loop for coordinated operation and improved system reliability. The outer loop system permits time diversity of different loads and waterflow diversity of different rivers to be used effectively for economic operation of the overall systems of the company. (USBR)
W69-01435

BULGARIA'S HYDRO-POWER POTENTIAL,
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01451

THE SENECA PUMPED-STORAGE PLANT,
Cleveland Electric Illuminating Co., Ohio.
Seymour B. Rock.
Proc Amer Power Conf, Vol 29, pp 720-730, 1967. 11 p, 8 fig, 3 ref.

Descriptors: *Pumped storage, *Hydroelectric powerplants, Draft tubes, Planning, Reservoirs, Design data, Intake structures, Penstocks, Optimum design, Pressure pipes, Conduits, Asphaltic concrete, *Pump turbines, Hydraulic turbines, Electric generators.
Identifiers: Pennsylvania, *Seneca Pump Storage Plt (Pa), Synchronous machines.

The 3-unit Seneca Pumped Storage Plant on the Allegheny River about 200 mi upstream from Pittsburgh, Pa., will have a rated capacity of 380,000 kw and is scheduled for service in mid-1969. Power facilities are being installed adjacent to the concrete-earthfill Kinzua Dam constructed by the Corps of Engineers. The floor of the upper reservoir, located on a plateau adjacent to the left abutment of the dam, will be about 700 ft above the water level behind the dam and 800 ft above the elevation of the river below the dam. Phases of the work discussed include: (1) planning considerations; (2) plant description; (3) design highlights, including synchronous starting, a divided draft tube, and an asphaltlined upper reservoir; and (4) optimizing plant design. The Pennsylvania Electric Co and The Cleveland Electric Illuminating Co made the planning studies; Harza Engineering Co performed engineering and construction management services. (USBR)
W69-01454

EVALUATION OF HARMONIC LEVELS ON AN HVDC TRANSMISSION LINE,
Allis-Chalmers, Milwaukee, Wis; University of Wisconsin, Madison.
D. H. Welle, A. G. Phadke, and D. K. Reitan.
Proc Amer Power Conf, Vol 29, pp 1100-1108, 1967. 9 p, 6 fig, 7 ref, append.

Descriptors: *Direct currents, *Extra high voltage, Waves, Rectifiers, Transmission lines, Converters (Electrical), *Interference, Attenuation, Graphical analysis, Analysis, Filters (Electromagnetic), Electric power, Resonance, Disturbances.
Identifiers: *Evaluation, *Harmonics, Propagation, Interties.

Using symmetrical components, the author discusses a convenient means of analyzing harmonic levels occurring on d-c transmission lines. The valve element of an hvdc converter functions as a switch, opening and closing in a predetermined sequence, and creating cyclic disturbances on the d-c system. Voltage discontinuities appearing on the output d-c voltage can create harmonic content in excess of 10 to 15%. An analysis based on the concept of steady-state traveling waves provides an insight into factors influencing harmonic levels and is useful in designing filters for d-c transmission lines. A normalized graph aids in determining the harmonic variation along the transmission line. Equations for computing the harmonic level along the line and a method of deriving the normalized graph are given. (USBR)
W69-01455

HIGH-VOLTAGE CIRCUIT BREAKERS WITH SWITCHING RESISTORS AND HIGH CURRENT RATINGS,
Allis-Chalmers, Boston, Mass.
L. A. Holden.
Proc Amer Power Conf, Vol 29, pp 1118-1125, 1967. 8 p, 8 fig, 1 tab, 4 ref.

Descriptors: Extra high voltage, *Circuit breakers, Electric currents, *Resistors, Surges, Transients, Electric power, Capacitance, Electrical equipment, Faults (Electrical), Oscillation, Transmission lines, Design, Electric insulation, *Interrupters, Reviews, Damping.
Identifiers: *Switching, *Switching surges, Current rating, Flashover, Overvoltage.

During the past 5 yr the electric power industry has made greater use of extra high voltage (345 and 500 kv) to transmit large blocks of power over extra long distances. There are 2 requirements of ehv system operation that can impose new capability requirements on circuit breakers for use in high-voltage systems operating in conjunction with ehv lines, either at the source or at load terminals. These are: (1) control of ehv line voltage surges on closing of low-side circuit breakers switching ehv lines on the low-voltage side of a transformer, and (2) continuous current ratings up to 3000 or 4000 amp to carry load currents associated with ehv line loadings. This paper reviews the general usage of resistors in circuit breakers, and through definition of the functions of various ohmic values of resistors used, introduces the application of surge control resistors in oil circuit breakers for low-side switching of ehv lines. A description is given of the development of breakers in the 115- and 138-kv class with continuous current ratings up to 4000 amp for carrying kva loads corresponding with ehv line capabilities. (USBR)
W69-01456

GIANT-SIZED HYDRAULIC TURBINES,
Bechtel Corp., San Francisco, Calif.; Acres Ltd., Toronto, Canada.
J. L. Haydock, and J. Gavin Warnock.
Amer Power Conf, Apr 1968. 36 p, 8 fig, 9 tab.

Descriptors: *Hydraulic turbines, Pump turbines, *Forecasting, Design, Manufacturing, Erection, Transportation, *Reviews, Economics, Mechanical engineering, Capital costs, Technology, Fabrication, Handling equipment, Foreign design practices, *Turbines, Specific speed.
Identifiers: Bulb turbines, *Hydraulic design, Canada, Tube turbines, Foreign research.

The past 25 yr of turbine building progress is reviewed, and predictions for 1980 are considered. Important aspects in the development trends of

hydraulic turbines that must be considered when forecasting the future include: (1) pressure applied by optimum economic development of hydropower sites; (2) advances in technology, particularly as applied to manufacturing and material techniques; and (3) function of the large hydraulic turbine in relation to power systems of the future. All facets of the economics of large hydraulic turbines that must be carefully considered are discussed. Modern technology indicates that hydraulic design will in no way limit the advance to the 2,000,000-hp frontier by 1980. Tabluations are given of large hydraulic turbines in operation, under construction, or planned. Large pump-turbines and bulb and tube turbines are listed. (USBR)
W69-01459

8D. Soil Mechanics

CHANGES IN THE PROPERTIES OF SETTLED LOESSIAL SOILS WITH DEPTH AFTER COMPACTION OF THE SOILS BY WETTING AND THE EFFECTS OF BLASTING,
I. M. Litvinov.
Transl from Osn Fundamenty i Mekh Gruntov, No 6, pp 24-25, 1967. Soil Mech Found Eng, No 6, pp 419-421, Nov-Dec 1967.

Descriptors: *Soil compaction, *Loess, Compaction tests, Soil physical properties, *Settlement, Explosions, Soil consolidation tests, Porosity, Blasts, *Compaction, Density, Moisture content, Soil mechanics, Foreign construction, Costs, Dynamics.
Identifiers: Blasting, Soil dynamics, Soil density, Foreign research, USSR.

The author presents a method of deep compaction of settled loessial soils by wetting and then subjecting the soil to the effect of blasting. Data on changes in properties of such soils with depth before and after compaction are presented. The method makes possible reduction of the danger of wet zones, more rapid compaction, and development of greater density. A graph of the soil density after compaction in tons/cu m vs depth indicates densities of 1.4 at 1 m, 1.47 at 3 m, 1.4 at 5 m, increasing to 1.62 at 10 m, and continuing near 1.62 to 20 m. The percent porosity of the soil vs depth shows 47.5% at 1 m, 46% at 3 m, 49% at 5m, decreasing to 40% at 20 m before blasting. The porosity was 47% at 1 m after blasting and decreased to approximately 40% at 10 m. The dynamic factor (blasting) reduced the thickness of the upper uncompacted zone of settled soil at one test site from 7-9 m to 4-6 m. The approximate cost/sq m of a layer compacted to 15 m was 7 rubles, 50 kopeks ($7.50). The method appears to be economical and reliable. (USBR)
W69-01409

PERFORMANCE MONITORING OF A DEEP COFFERDAM IN SENSITIVE CLAY,
James F MacLaren Ltd, Toronto, Canada.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01413

COMPOSITIONAL AND ENVIRONMENTAL INFLUENCES ON THE STRESS-STRAIN-TIME BEHAVIOR OF SOILS,
California Univ, Berkeley.
Terence J. Hirst, and James K. Mitchell.
Soil Mech Bitum Mater Res Lab Rep No TE 68-4, Univ California, Berkeley, Apr 1968. 242 p, 70 fig, 10 tab, 63 ref, 3 append.

Descriptors: Clays, Cohesive soils, Compressive strength, Creep, Grain shapes, Consolidation, Failure (Mechanics), Gradation, Grain sizes, Soil structure, Kaolin, Sensitivity, Shear tests, Triaxial compression, *Clay minerals, *Soil texture, *Stress-strain curves, Triaxial stress, *Soils, Soil mechanics, Bibliographies, Time, Sands.
Identifiers: Strain rate, Compressibility, Undrained shear strength, Illite.

Influences of the clay mineral type, and the grain shape and size distribution of nonclay particles on consolidation, strength, and creep characteristics of prepared sand-silt-clay mixtures can be interpreted in terms of interactions between the clay and granular phases. The interference between clay and nonclay phases that develops during consolidation prevents either phase from consolidating to the void ratio it would attain in the absence of the other phase. The stiffness of normally consolidated mixtures varies with clay content but is essentially independent of the grain size distribution and particle shape characteristics of the granular phase. Adding granular particles to a sand-silt-clay mixture may result in increased or decreased strength at a given consolidation pressure, depending on whether the strength increase provided by the granular phase exceeds the strength reduction in the clay phase that results from the additional interference to clay consolidation caused by the granular phase. Changes in undrained strength occurring during sustained loading depend on the creep stress level, duration of load application, and clay type, but are independent of the consolidation pressure and type and amount of the granular phase. (USBR)
W69-01420

LANDSLIDES DURING EARTHQUAKES DUE TO SOIL LIQUEFACTION,
California Univ., Berkeley.
H. Bolton Seed.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 94, No SM5, pp 1053-1122, Sept 1968. 70 p, 66 fig, 1 tab, 73 ref.

Descriptors: *Earthquakes, Faults (Geology), *Landslides, Void ratios, *Liquefaction, Rock mechanics, Seismic waves, Seismic properties, Lenses (Soils), Bibliographies, *Seismic investigations, Seismology, Pore water pressures, Stability analysis, Saturation, Shear strength, Sands, Pore pressures.
Identifiers: Stability, *Slope stability, Terzaghi lecture, *Seismic stability, Soil dynamics, Earthquake damage.

The 4th Terzaghi lecture has 2 main objectives. First, frequency and conditions of occurrence of landslides due to soil liquefaction during earthquakes are examined. In addition to discussing individual events during particular earthquakes, a list of known slides in which liquefaction has played a part is included to evaluate the severity of the problem. A review of the list shows that the slides have been initiated by liquefaction of saturated sandy soils in a loose to medium dense condition resulting from earthquakes varying in magnitude from 5.5 to 8.5 points (Richter) and at epicentral distances of several miles to hundreds of miles. This type of slide must be seriously considered in seismically active regions. The second objective is to emphasize the importance of minor geologic and technical details in determining the occurrence and nature of landslides during earthquakes due to soil liquefactions. (USBR)
W69-01438

AN ANALYSIS OF THE SHEFFIELD DAM FAILURE,
California Univ., Berkeley and Los Angeles.
H. Bolton Seed, K. L. Lee, and I. M. Idriss.
Soil Mech Bitum Mater Res Lab Rep No TE-68-2, Univ California, Apr 1968. 101 p, 44 fig, 2 tab, 13 ref.

Descriptors: *Dam failures, *Dam foundations, Embankments, Compaction, Soil stability, *Stability analysis, *Earth dams, *Earthquakes, Seismic investigations, Seismic properties, Shear strength, Liquefaction, Sands, Impervious blankets, Cutoff trenches, Safety factors, Soil liquefaction, Silts, Seismic design.
Identifiers: Earthquake engineering, Earthquake damage, Soil dynamics, *Sheffield Dam (Calif), Seismic studies, Cyclic loads, Seismic stability.

An attempt is made to reconstruct the circumstances leading to the Sheffield Dam failure during the 1925 Santa Barbara earthquake. Field observations and dynamic analyses indicate that failure was caused by liquefaction. The downstream slope failed because the upstream slope was supported by the 15- to 18-ft-deep reservoir. The 25-ft-high dam was constructed of silty sand on a foundation of similar material about 6 ft thick. The embankment was compacted by equipment travel to a relative density of about 35%. The foundation and lower portion of the embankment were saturated by seepage. The earthquake had a magnitude of about 6.3 with an epicenter located about 7 mi from the damsite. Resulting ground accelerations had a maximum amplitude of about 0.15 g, a frequency of about 3 cycles/sec, and a duration of significant shaking of 15 to 18 sec. Dynamic response analyses indicate the dam was probably subjected to a series of earthquake-induced inertia forces equivalent to 10 uniform force cycles at maximum amplitude. Cyclic-loading triaxial compression tests indicated a factor of safety of 1.15 against failure by soil liquefaction. A similar analysis using results of simple shear tests indicated a factor of safety of 0.75 and a failure surface in good agreement with the actual one. (USBR)
W69-01444

A STUDY OF PORE WATER PRESSURES DURING ELECTROKINETIC TREATMENT,
Cornell Univ., Ithaca, N. Y.
Melvin I. Esrig.
Soil Eng Ser Res Rep No 6, Cornell Univ, Ithaca, N Y, Mar 1968. 87p, 42 fig, 2 tab, 17 ref, append.

Descriptors: *Pore water pressures, *Negative pore pressures, *Pore pressures, Consolidation, Electroosmosis, Electrophoresis, Boundaries, Soil stabilization, *Electrokinetics, Electrolytes, Bibliographies, Soil physical properties, Soil mechanics, Soil chemical properties, pH, Soil consolidation tests, Ions, Permeability, Piezometers.
Identifiers: Soil water movement, Soil conductivity.

Pore water pressures in soils during electrokinetic treatment are considered on a semitheoretical basis. Results of an experimental program on problem areas are given. The work was sponsored by the U S Army Materiel Command as a feasibility study of soil stabilization for military mobility. Pore water pressures in soils may be due to various causes, one being an externally applied hydraulic head. Only pressures from a potential field (transmitted to the soil through electrodes) or from physical-chemical changes in the soil are discussed. Pore water pressures in cylindrical soil samples under a uniform potential field were investigated for systems with: (1) water at one end, (2) water at both ends, and (3) both ends closed. The negative pore pressure of 5 psi was measured. Changes in pH, ion concentration, and applied voltage were interrelated and influenced pressures in soils subjected to electrokinetic treatment. Pore water pressures will develop even in a uniform field where water has access to the sample; they are related to discontinuities in pH, ion concentration, and the electric field. (USBR)
W69-01464

A FEASIBILITY STUDY OF ELECTROKINETIC PROCESSES FOR STABILIZATION OF SOILS FOR MILITARY MOBILITY PURPOSES,
Cornell Univ., Ithaca, N. Y.
Melvin I. Esrig.
U S Army Eng Waterways Exp Sta Rep 4, July 1967. 86 p, 25 fig, 5 tab, 23 ref, 2 append.

Descriptors: *Soil stabilization, *Electrokinetics, *Soil treatment, Montmorillonites, Quartz, Shear tests, Vane shear tests, Consolidation, *Shear strength, Electrical properties, Permeability, Electroosmosis, Clays, pH, Soil mechanics, Bibliographies.
Identifiers: *Soil strength, Illite.

Results are presented of a laboratory investigation of the effects of electrokinetic treatment on the strength of consolidated samples of illitic and montmorillonitic soils. Samples were remolded specimens of sifted illite and montmorillonite mixed with a manufactured quartz silt. Average strength increases of from 1.5 to 40 times occurred when samples were treated electrically for 96 hr. Although strength increases for montmorillonitic samples are similar in magnitude to those occurring in illitic samples, they could not be related to the clay fraction. Electrokinetic treatment is most beneficial when the ratio of energy input per unit volume of clay fraction is the greatest. This indicates that electrokinetic treatment is most useful in soils with clay contents of between 5 and 20%. The coefficient of electrokinetic permeability varied throughout the treatment period. An equation is suggested relating this coefficient to several soil index properties. (USBR)
W69-01466

8E. Rock Mechanics AND Geology

SLOPE STABILITY PROGRAM OF KENNECOTT COPPER CORPORATION,
Kennecott Copper Corp, New York, N Y.
Carl D. Broadbent.
Amer Inst Mining Eng Annu Meet, New York, Feb 1968. 31 p, 11 fig, 12 ref.

Descriptors: *Critical slopes, *Cut slopes, *Landslides, Optimum use, Stress, *Stability analysis, Models, Materials stability, Ground water, Shear strength, Shear failures, Rock mechanics, Three-dimensional, Pits, Slopes, Economics, Water pressures, Shear resistance.
Identifiers: Failure surfaces, Open pit mining, Kennecot Copper Corp, *Slope stability.

The goal of slope mechanics in open pit mining is to produce efficient and safe slopes and to optimize slopes and minimize stripping by steepening the slopes to their maximum stable limit. The Kennecott Copper Corp established a slope mechanics capability in 1956, and recent work at their Kimberly pit provides a 3-dimensional picture of stability variables. Slope failures can result from rockfalls, rotational shears, block flows, or plane shears. The location, intensity, and orientation of planes of weakness are treated separately because of their influences on slope failure. Kennecott integrates technology into a unified slope mechanics system, balancing effective slope stress and strength. Their approach is to: (1) measure or estimate structure, strength, stress, and ground water; (2) define operating variables as ore profiles, topography and operation design; and (3) successively evaluate the stability of the most economic design slope with a stability model until the overall stability factor is secured. Slope analysis has reached a productive stage in which the cost per ton of ore for an effective program is compensated by potential savings. (USBR)
W69-01412

LANDSLIDES DURING EARTHQUAKES DUE TO SOIL LIQUEFACTION,
California Univ., Berkeley.
For primary bibliographic entry see Field 08D.
For abstract, see .
W69-01438

SONAR TOOL SURVEYS UNDERGROUND CAVITIES,
Prakla Gmbh, Hannover, W. Germany.
Ernest Nolte.
Oil Gas J, Vol 66, No 38, pp 76-78, Sept 1968. 3 p, 3 fig.

Descriptors: *Sonar, Drill holes, Boreholes, Underground structures, *Subsurface investigations, Surveying, *Surveying instruments, Acoustic equipment, Measuring instruments, Instrumentation, Engineering geology, Sonic waves, *Soundings, Cavities, Foundation investigations.
Identifiers: Probes (Instruments), *Underground openings, *Underground cavities, Foreign products, West Germany, Sonic probes, Remote sensing.

A newly developed sonar probe permits complete profiling of underground cavities. The instrument is suspended on a cable, lowered into a borehole, and records horizontal and vertical cross sections for determining the volume and shape of underground cavities. The tool has a rotating and tilting head that overcomes the limitations of horizontally scanning sonar. The head may be rotated 360 deg around the axis and tilted to an angle of 90 deg for upward and downward scanning. Three sonar operating frequencies of 200, 600, and 1000 kc/sec are provided to improve scanning resolution for varying transmission and reflection conditions and distances. The 600-kc/sec frequency is commonly used for measuring distances to 300 ft. Correct depths of the cavity are measured by an electromagnetic detector that uses casing collars as reference points. The probe is 3-1/2 in. in diameter, 12 ft long, and weighs 200 lb. (USBR)
W69-01449

THE RESULTS AND OBJECTIVES OF SOVIET SEISMOLOGY)1917-1967(,
E. F. Savarenskii.
Phys Solid Earth, No 11, pp 721-727, Nov 1967. 7 p.

Descriptors: *Seismology, *Earthquakes, *Seismographs, Foreign design practices, Seismic waves, Geophysics, Seismic investigations, Measuring instruments, Engineering geology, Seismic design instrumentation, Reviews.
Identifiers: Earthquake engineering, Epicenters, Earthquake zones, Earthquake focus, USSR.

The objectives of Soviet seismology are: (1) planning and developing earthquake-proof structures and buildings, (2) researching foreshocks to perfect methods of predicting earthquakes, and (3) investigating the structure of the earth from seismic data. The paper discusses the steady progress of seismology in Russia before and after 1917; during the first 5-yr plans; in the postwar period; in the 1960's; and after the 1966 Tashkent earthquake. The destructive Ashkhabad earthquake in Oct 1948, initiated a period of intensive development to correct certain defects in the national system, such as the accuracy of locating epicenters and establishing the depth of foci. The earthquake demonstrated that earthquake-proof buildings, taking into account the seismic zoning, suffered only slight damage although the tremor reached 10 scale units in certain localities. The author concludes that Russia is approaching the solution of the basic problems of seismology by developing methods to predict earthquakes and design reliable and economical earthquakeproof buildings. (USBR)
W69-01460

DETERMINATION OF THE STRESS IN ROCK UNAFFECTED BY BOREHOLES OR DRIFTS, FROM MEASURED STRAINS OR DEFORMATIONS,
Kyoto Univ., Japan.
Y. Hiramatsu, and Y. Oka.
Int J Rock Mech Mining Sci, Vol 5, No 4, pp 337-353, July 1968. 17 p, 8 fig, 5 tab, 10 ref.

Descriptors: *Stress analysis, *Rock mechanics, *Stress distribution, Stress, Strain, Elasticity, Boreholes, Drill holes, Strain measurement, Strain gages, Drifts, Measuring instruments, Deformation, Subsurface investigations, Tunnels.
Identifiers: Borehole deformation gage, Foreign research, Japan.

Formulae used to quantitatively determine the state of stress in rock unaffected by boreholes or drifts are discussed. Investigations consisted of: (1) measuring variations in borehole diameters, (2) measuring strain on the bottom surface of boreholes, (3) measuring strain on the wall surface of boreholes, (4) measuring variations in boreholes in an oblique dimension, (5) combinations of the above, (6) measuring strains on the walls of drifts or shafts, and (7) using the calibration tests. The study assumed that the ground was perfectly elastic and in a general state of stress, and that the direction of the boreholes or drifts in which measurements were made could be optional. Numerical examples and a discussion of the accuracy of the first 4 procedures indicate that the highest accuracy would be secured using variations in borehole diameters. The least number of boreholes or drifts necessary for each measurement was noted. (USBR)
W69-01462

8F. Concrete

THE BEARING STRENGTH OF CONCRETE LOADED THROUGH RIGID PLATES,
Sydney Univ, Australia.
N. M. Hawkins.
Mag Concr Res, Vol 20, No 62, pp 31-40, Mar 1968. 10 p, 9 fig, 5 tab, 16 ref.

Descriptors: Concrete, *Concrete testing, Concrete structures, Failure (Mechanics), *Bearing values, *Bearing capacities, *Plates, Strength of materials, Ultimate loads, Eccentric loading, Loading rate, Compressive strength, Load distribution, Bibliographies, Internal friction, Cracks, Cracking.
Identifiers: Concrete properties, Foreign research, *Bearing pressure, *Bearing strength, Australia.

Approximate expressions are developed for bearing strength of concrete members loaded through rigid plates. Ultimate strengths are reported for 18 series of tests in which effects of concentric and eccentric loading, geometry of specimen and loading plate, and type and strength of concrete were evaluated. General expressions for bearing strength are developed on the basis of failure modes observed in the tests. The majority of specimens were 6-in. cubes loaded through 3/4-in.-thick steel plates. Specimens were in direct contact with the platens of a testing machine except during eccentric loading tests when a roller system was inserted between the upper platen and bearing plate. The loading rate was approximately 30 psi/sec. Vertical cracks on the sides of the specimen closest to the loaded area were the first failure warning. Shortly after this warning, the maximum load was reached and a wedge of concrete was punched out from beneath the bearing plate. Simple failure models are proposed for concentric and eccentric loading conditions. Any increase in bearing capacity above the compressive strength of the concrete is directly dependent upon the angle of internal friction; the bearing zone should be dense and air voids and shrinkage cracks minimized. (USBR)
W69-01419

DIRECT DESIGN METHOD FOR PRESTRESSED CONCRETE SLABS,
Catholic University of America, Washington, D C.
Chen-Hwa Wang.
J Prestressed Concr Inst, Vol 13, No 3, pp 62-72, June 1968. 11 p, 5 fig, 6 ref, append.

Descriptors: *Prestressed concrete, Design criteria, Concrete, *Design tools, Design, *Slabs, Concrete structures, Structural design, Moments, Prestressing, Compressive strength, Bending moments, Load distribution, Continuous beams, Supports, Live loads, Dead loads, Reinforced concrete, Reinforcing steel.
Identifiers: Design improvements, Design practices.

A direct design method for prestressed concrete slabs is based on the load-balancing analysis for obtaining the desired minimum or allowable maximum compressive stresses at the extreme fibers of control sections. Control sections should be selected first considering maximum moment and

economy of the entire slab, then behavior of the slab under design load can be predicted. The section with maximum bending moment may be considered as the control section in a simple span. A continuous slab has several maximum moment peaks in the middle portion of spans and over supports. Therefore, selecting the control section depends on the type of structure and engineering judgment. Direct design equations for slabs under uniformly distributed loads are presented and their derivations, based on the load-balancing analysis, are given in the appendix. An 8-step design procedure is illustrated by 3 examples: (1) a one-way 7-1/2-in. roof slab weighing 94 psf and carrying a live load of 75 psf, (2) an 8-in. slab supported on 4 walls to be posttensioned in 2 directions for a live load of 100 psf, and (3) a 7-1/2-in. flat plate weighing 94 psf and carrying a live load of 100 psf. (USBR)
W69-01423

STRENGTH AND ELASTIC PROPERTIES OF CONCRETE IN FLAMING GORGE DAM,
Bureau of Reclamation, Denver, Colo.
K. B. Hickey.
Bur Reclam Rep No C-1139A, July 1968. 23 p, 9 fig, 11 tab.

Descriptors: Concrete, Compressive strength, Poisson ratio, Pozzolans, Concrete control, Elasticity modulus, *Concrete dams, *Concrete testing, Concrete technology, *Mass concrete, Laboratory tests, Concrete mixes, Age, Cores.
Identifiers: *Concrete properties, Flaming Gorge Dam (Utah), Colorado River Storage Project, Longtime tests.

Results of load tests performed at 6 mo and 1, 3, and 5 yr on cores drilled from the mass concrete in Flaming Gorge Dam indicate good concrete in the structure. This study is part of a series in the Bureau of Reclamation's 20-yr evaluation of strength and elastic properties of concrete in various dams. Some findings, based on tests of 142 cores, are: (1) average 5-yr compressive strength of interior concrete, containing approximately 2 sacks of cement and 90 lb of calcined shale pozzolan per cu yd, is 3640 psi (258 kg per sq cm); (2) 5-yr strength of exterior concrete with 3-1/3 sacks of cement per cu yd is 4700 psi (330 kg per sq cm); (3) strengths of both concretes increase slightly with age; (4) average 5-yr compressive modulus of elasticity of the concretes is 4.0 million psi (280 thousand kg per sq cm); and (5) modulus of exterior concrete decreases slightly with age, while modulus of the interior material increases slightly with age. Cement efficiencies, coefficient of variation of strengths, and Poisson's ratios are discussed. (USBR)
W69-01446

RETENTION AND PREVENTION OF FOUNDATION UPLIFT FROM PRESSURE GROUTING,
Resources Agency, Sacramento, Calif.
Robert J. Akers.
Tech Memo No 30, Dep Water Resour, State of Calif, Mar 1968. 8 p, 2 fig.

Descriptors: *Grouting, *Uplift pressures, Displacements, Tiltmeters, Foundations, Extensometers, Strain gages, Instrumentation, Surveying, Cracking, *Dam foundations.
Identifiers: Uplift gages, *Grouting pressure.

Detecting foundation displacement during grouting and determining the pressures involved are important in a successful grouting program. Use of resultant data will permit grouting at the highest safe pressure. Three methods of detecting foundation uplift from excess grouting pressures are: (1) precise leveling surveys, (2) the use of tiltmeters, and (3) the use of displacement gages or extensometers. These methods depend on the assumption that subsurface (foundation) movement will be evident on the surface, or with an extensometer, will cause displacements between the surface and 2-hole reference points. A gage-alarm extensometer-type instrument developed by the Calif State Department of Water Resources is described. Criteria considered were: (1) instantaneous response to displacement, (2) adequate accuracy, (3) audible and visual alarm system actuated by a predetermined displacement, (4) ease of installation, (5) ruggedness and portability, and (6) low cost. (USBR)
W69-01463

8G. Materials

CORROSION AS A PRIMARY CAUSE OF CAST-IRON MAIN BREAKS,
Hinchman Co, Detroit, Mich.
John H. Fitzgerald, III.
Amer Water Works Ass J, Vol 60, No 8, pp 882-897, Aug 1968. 16 p, 10 fig, 35 ref.

Descriptors: *Water pipes, Water supply systems, *Pipelines, Cathodic protection, Pipes, *Cast iron, Corrosion, *Corrosion control, Thickness, Backfills, Metallurgy, Protective coatings, Bibliographies, Electrical resistivity, Direct currents, Costs.
Identifiers: Galvanic corrosion, Underground corrosion, Ductile cast iron, Gray cast iron, *Cast iron pipe, Soil resistivity, Corrosion tests.

The majority of breaks in cast iron water mains occur at locations where the pipe wall has been weakened. Weakening results from graphitic corrosion of cast iron, and although failure may be due to stress, the direct cause is corrosion. The corrosion process is reviewed and data are cited to show the relation between breaks and known corrosion phenomena. Recommendations for corrosion control and reduction of main breaks are discussed. Corrosion control may not pay off in the first 5 to 10 yr; savings from corrosion control are significant in water systems designed to last 100 yr. Eliminating the majority of breaks reduces maintenance expense, traffic delays, and customer ill will. Corrosion control is a management responsibility and is essential to the efficient long-term performance of a piping system. (USBR)
W69-01429

PLASTIC MEMBRANES REPAIR DAMS,
C. F. Groner.
Energy Int, Vol 5, No 8, pp 16-18, Aug 1968. 3 p, 4 fig.

Descriptors: *Impervious membranes, *Repairing, Maintenance, Operation and maintenance, Concrete, Concrete structures, *Concrete dams, Epoxies, Deterioration, Leakage, *Plastics, Membranes, Glass fibers, Bituminous materials, Foreign construction, Materials, Mortars.
Identifiers: Polyesters, Polyvinyl chloride, Norway, Dam facings.

Various polyester and epoxy materials have been used to repair dams in Norway during the last 5 yr. Nomeland Dam, a 28-m high and 140-m long gravity structure, developed substantial leaks, especially along numerous construction joints. Repair operations consisted of cleaning the upstream face with steel brushes and scrapers, patching surface irregularities with cement mortar mixed with polyvinyl chloride, and applying a built-up membrane of polyester and fiberglass fabric. Repairs of an inverted arch concrete intake structure of the Tinfos hydroelectric project are described. The shutdown schedule would not permit complete drying of the concrete, restricting selection of materials to epoxy-type plastics. The membrane material selected (bituminous mortar mixed with epoxy) does not harden into a brittle membrane, remaining reasonably pliable after curing. (USBR)
W69-01434

THEORY AND PRACTICE OF PLASTIC PIPING,
Mooney Brothers Corp., Little Falls, N. J.
Philip A. Schweitzer.
Air Cond, Heat Vent, Vol 65, No 5-9, pp 41-56, 45-51, May-Sept 1968. 23 p, 14 fig, 47 tab.

Descriptors: *Water pipes, Pipe fittings, *Pipelines, *Plastic tubing, Valves, Polyethylenes, Epoxies, *Pipes, *Plastics, Reinforcing, Welding, Thermoplastics, Corrosion, Design criteria, Design data, Materials, Joints, Supports, Asbestos.
Identifiers: Corrosion resistance, *Fiberglass plastic pipes, *Plastic pipes, Reinforced plastics, Glass reinforced plastics.

Plastic piping materials are reviewed to provide information and data on the advantages of the latest plastic piping materials. The review includes: design criteria, pipe dimensions, pipe support, field fabrication and jointing methods, valves, and accessory equipment. Characteristics and design data are discussed for polyvinyl chloride, polyvinyl dichloride, polypropylene, vinylidene fluoride, polyethylene, chlorinated rubber, and fiber-reinforced plastic pipe. Reinforced plastic pipes include glass fiber-reinforced polyester, blue asbestos-reinforced phenolic resin, blue asbestos-reinforced epoxy, and glass fiber-reinforced epoxy. Glass fiber and asbestos are combined with polyester and epoxy to produce piping systems that will withstand high pressures and temperatures. (USBR)
W69-01439

A CATIONIC WATER-BORNE SOIL SEALANT,
Armour Industrial Chemical Co., Chicago, Ill.
Jack N. Dybalski.
Symp New Uses for Asphalt, Amer Chem Soc 156th Annu Meet, Atlantic City, N J, Sept 1968. 13 p.

Descriptors: *Asphalt, Bituminous materials, *Linings, *Canal linings, *Emulsions, Reservoirs, Irrigation canals, Toxicity, *Seepage, Hydraulic structures, Seepage losses, Permeability, Adsorption, Soils, Operation and maintanance, Fish.
Identifiers: *Cationic asphalt emulsions, Surfactants, *Soil sealants, *Underwater canal sealing, Seepage control.

Many materials have been used for lining hydraulic structures, including concrete, asphalt hot mixes, asphalt-based prefabricated panels, buried asphalt membranes, clay, and a variety of plastic and elastomeric films. Each of these materials requires a laborious construction method and a relatively dry, water-free area for installation. These materials are either too costly or involve drying up the structure and time-consuming installation. Such factors point to the need for a waterborne soil sealant which, for speed and convenience, can be added directly to the water to seal the underlying soil. Laboratory and field work during the past 10 yr have shown the superior properties of cationic asphalt emulsions. These properties include a high affinity for almost all surfaces and the ability to strongly adhere to soil particles in the presence of water. Toxicity studies indicate that the sealant is nearly nontoxic by ingestion and nonirritating to ocular and skin tissue. The sealant acts as a physical toxicant to fish by sealing the gills, suggesting a safe method for removing trash fish and snails. (USBR)
W69-01440

LABORATORY AND FIELD INVESTIGATIONS OF PLASTIC FILMS AS CANAL LINING MATERIALS OPEN AND CLOSED CONDUITS SYSTEMS PROGRAM,
Bureau of Reclamation, Denver, Colo.
M. E. Hickey.
Bur Reclam Rep No ChE-82, Sept 1968. 47 p, 5 fig, 14 tab, 16 photo, append.

Descriptors: *Canal linings, Materials, *Buried membranes, *Impervious membranes, Flexible linings, Soil compaction, Vinyl plastics, Laboratory tests, *Polyethylenes, Canal seepage, Subgrade, Irrigation canals, Earth materials, Field investigations, Ponding tests, Cutoffs, *Lower cost canal linings, Plastics.
Identifiers: *Open and Closed Conduit System Project, Seepage control, *Polyvinyl chloride, *Plastic film.

Accelerated laboratory testing and field performance evaluations of polyvinyl chloride (PVC) and polyethylene plastic film indicate that these materials can be used satisfactorily as buried membrane linings. Both materials must be compounded by the manufacturer specifically for canal lining purposes to ensure longtime service. Neither material is suitable as exposed lining and must be protected by a minimum of 1 ft earth cover. Laboratory analysis of PVC lining after 7 yr service and polyethylene lining after 4 yr service indicates no change in these materials. PVC and polyethylene plastic membrane linings in use for 10 yr are giving excellent service. These linings are low cost and easy to install, requiring a minimum of equipment and skilled labor. Short-term laboratory tests on newer ethylene vinyl acetate copolymer and chlorinated polyethylene plastic films indicate that these materials have possibilities as canal linings. Continued testing of these plastics is necessary to ascertain possible advantages over PVC and polyethylene linings. (USBR)
W69-01447

DEVELOPMENT AND USE OF PRESTRESSED STEEL FLEXURAL MEMBERS.

Proc Amer Soc Civ Eng, J Struct Div, Vol 94, No ST9, pp 2033-2060, Sept 1968. 26 p, 12 fig, 55 ref, append.

Descriptors: *Beams, *Prestressing, *Girders, Structural steel, Steel, Safety factors, *Structural members, *Flexural strength, Bibliographies, Composite structures, Bending moments, Tensile stress, Stressing cables, Stess, Stress-strain curves, Trusses, Design criteria, Structural design, Structural engineering.
Identifiers: *Prestressed steel, Hybrid beams, Prestressing systems, Composite beams, I-beams.

Prestressed steel enables the designer to achieve a greater elastic range than is possible for an identical nonprestressed member. This extended range enables a prestressed steel member to resist relatively large overloads without suffering permanent distortion. Prestressing is a means of efficiently utilizing various strength steels in builtup beams or girders, so that significant savings in weight and depth of members can be achieved. Savings are realized without reducing the factor of safety against yielding for any of the steels, but the margin of safety against the plastic mechanism is reduced. (USBR)
W69-01450

EFFECT OF RUST AND SCALE ON THE BOND CHARACTERISTICS OF DEFORMED REINFORCING BARS,
West Virginia Univ., Morgantown; Corps of Engineers, Fort Benning, Ga.
E. L. Kemp, F. S. Brezny, and J. A. Unterspan.
J Amer Concr Inst, V 65, No 9, pp 743-756, Sept 1968. 14 p, 11 fig, 6 tab, 11 ref.

Descriptors: *Reinforced concrete, *Reinforcing steel, *Deformed bars, Reinforcing, *Mill scale, Specifications, Concrete testing, Bars, Design criteria, Materials testing, Concrete, *Concrete technology, Oxidation, Corrosion, Stress.
Identifiers: *Bond tests, Bond strength, Rusting, Test results.

Bond characteristics of ASTM A 432 reinforcing bars were investigated under a wide range of scale and rust conditions. The bar surface condition was the principal parameter studied. Test results indicate that bond characteristics of deformed reinforcing bars meeting ASTM A 305 specifications are not adversely affected by varying degrees of surface rust or ordinary mill scale, provided the bar meets minimum ASTM weight and deformation height requirements. Deformation dimensions appear to govern bond characteristics of rusty bars in that these bars behave similarly to companion as-rolled bars. Current bond requirements seem conservative, especially for smaller bars, because of the 800-psi maximum stress limit. Concrete strength appears to control overall bond behavior, particularly slip and deformation, more than the surface condition of the bar. (USBR)
W69-01452

8H. Rapid Excavation

CHANGES IN THE PROPERTIES OF SETTLED LOESSIAL SOILS WITH DEPTH AFTER COMPACTION OF THE SOILS BY WETTING AND THE EFFECTS OF BLASTING,
For primary bibliographic entry see Field 08D
For abstract, see .
W69-01409

ANALYSIS OF EXPLOSIVE EXCAVATION,
State Scientific-Research Institute for Special Planning, USSR.
R. Ia. Strausman.
Trans. from Vzryvnoe delo, Sb 61/18, pp 175-187, 1966. Bur Reclam Transl 774, Oct 1968. 20 p, 8 fig, 3 ref.

Descriptors: *Explosions, Explosives, *Excavation, *Cratering, Canals, Craters, Foreign design practices, Mathematical analysis, Design tools, Data reduction, Field data, Design standards, *Charges (Explosives), Rock excavation, Soils.
Identifiers: USSR, *Explosive excavation, Canal construction.

A Soviet research institute, using correlation analysis methods, examined records from actual explosions carried out in the USSR from 1938-1963, to determine the dynamics of excavating charges and to refine design methods of longitudinal structures such as canals. The analysis was limited to explosions having a single-row placement of charges at depth to 20 m in 3 classes of soils: sandy clays and gravels; clays; and rocks such as limestones, sandstones, and slates. Results showed that: (1) M M Boreskov's formula for determining charge weight is justified for cratering factors (n) from 1 to 3; (2) this formula is accurate for row charges in channel excavation when n = 2 to 3, without a correction factor; (3) this factor, based on relations established by the analysis between various parameters in the formula, allows computing row-charge explosive excavation for channels when n ranges from 1 to 3; (4) the experimental study of geometric shapes and dimensions of craters determined the differences between true and apparent craters and made possible the development of a formula for computing the apparent depth of excavation; and (5) best results were obtained by using charges with n equal to or greater than 2.5. (USBR)
W69-01465

09. MANPOWER, GRANTS AND FACILITIES

9A. Education)Extramural(

WATER RESOURCES RESEARCH INTERESTS IN THE SENIOR COLLEGES AND UNIVERSITIES OF NORTH CAROLINA.
North Carolina University, Chapel Hill.

Water Resour Res Inst Rep 3, Univ N Car, Apr 1967. 22 p. OWRR Project A-999-NC.

Descriptors: *Water resources, Water Resources Research Act, Grants, Manpower, Universities, North Carolina, Research facilities, *Scientific personnel.

The water resources research interests of faculty members of the senior colleges and universities of North Carolina are summarized. Many of the scientists listed in this report, while presently devoting their full attention to nonwater related research, have indicated sufficient interest in water resources to suggest their possible involvement in this field. This represents a reservoir of potential research capability which can be drawn upon as circumstances permit.
W69-01253

WATER RESOURCES CENTER)GA. INST. OF TECHNOLOGY(.
State of Georgia, Atlanta.

17 Ga Code Ann, Secs 17-401 to 17-403 (1967).

Descriptors: *Georgia, Legislation, *United States Research development, Training, *Water resources, *Universities, Local governments, Contracts, Grants, Inter-agency cooperation.
Identifiers: Georgia Institute of Technology.

The Georgia Institute of Technology is empowered to operate a center for research and training in relation to water and resources affecting water. The findings and recommendations arising from such research are to be published or otherwise made available. The Center is authorized to use federal funds made available by grants and to use matching federal funds for expenses of specific water resources research projects. The center can enter into contracts or agreements with other colleges or universities, the federal government, local government units of this state and other individuals for specific research relating to water problems. (Childs-Fla)
W69-01301

9D. Grants, Contracts, AND Research Act Allotments

FEDERAL GRANTS FOR CLEAN WATER.

Fed Water Pollut Contr Admin Publ CWA-6, Ja 1968. 12 p.

Descriptors: *Grants, Research and development, *Contracts, Planning, *Water pollution control, Legislation, Application methods, Water resource development.
Identifiers: *Federal Water Poll Cont Act, *Research and dvlpmt centers, *Clean Water Restoration Act.

Each of the grant programs administered by the Federal Water Pollution Control Administration described in this booklet. The purpose, financial basis, method of distribution, matching provision, who may receive federal aid, application procedure and legal basis is given for each of the following grant programs: (1) Grants for comprehensive basin planning, (2) Training grants and research fellowships, (3) Research, development and demonstration grants and contracts, (4) State and interstate agency program grants, (5) Grants for waste treatment works construction, and (6) Appalachian regional development grants for waste treatment works construction. (S. Mayer-FWPCA
W69-01240

ANNUAL REPORTS OF THE CUMBERLAND RIVER BOARD, THE NORTHUMBERLAND AND TYNESIDE RIVER BOARD, AND THE WEAR AND TEES RIVER BOARD FOR THE YEAR ENDED 31ST MARCH, 1964.
Cumberland River Board, the Northumberland and Tyneside River Board and the Wear and Tees River Board.

90 pp, 15 graphs, 8 tables, 3 plates; 58 pp, 2 gr; pp, 4 pl, 1 map.

Descriptors: *Storm runoff, *Water pollution, *Waste dilution, Standards, *Overflow.

These reports contain information on water resources, fisheries, and prevention of pollution, including the quality of water and sources of pol

tion in individual rivers; standards for effluents from sewage works, storm-sewage tanks and overflows, individual properties, farms, and trade premises. In the Wear and Tees area, serious pollution, with obvious pollution by crude sewage, was observed in a small stream following a heavy storm, showing that overflows of storm-sewage are not adequately diluted by the increasing flow of the receiving stream when the stream is small and the storm-sewage overflow setting is low.
W69-01508

TWELTH AND THIRTEENTH ANNUAL REPORTS BEING FOR THE YEARS ENDED 31ST MARCH, 1963 AND 31ST MARCH, 1964.
Lancashire River Board.

102 pp and 106 p respectively.

Descriptors: *Storm runoff, *Overflow, *Water pollution.
Identifiers: *Storage tanks, *Urban drainage.

These reports contain information on water resources and the prevention of river pollution, both of which were affected by the severe cold weather early in 1963. One of the principal problems in the industrialized parts of the area is the pollution caused by storm sewage overflows, and to alleviate pollution caused by the 'first flush' of storm sewage overflows the Board has suggested the provisions of holding tanks. An investigation was begun into the factors causing growth of Sphaerotilus natans in a river below the outfall from a paper mill where suspended solids content and BOD of the effluent are vary low. Other special investigations included studies on the Wyre estuary to determine the composition and rate of discharge of effluents which could be considered unlikely to harm migratory fish. The criteria used in assessing the degree of pollution of a river or stream are summarized.
W69-01509

TWELFTH AND THIRTEENTH STATUTORY ANNUAL REPORTS, YEARS ENDED 31ST MARCH, 1963 AND 31ST MARCH, 1964.
Trent River Board.

116 pp, 2 maps, 6 plates.

Descriptors: *Water pollution, *Storm runoff, *Overflow, Surface runoff.
Identifiers: *Storm sewers, *Suspended solids.

These reports of the Trent River Board contain sections on water resources, fisheries, and prevention of river pollution, including information on water quality (which is interpreted in relation to the discharge of polluting waste waters and the effects of severe cold weather); remedial action; and standards for effluents. Chemical data obtained in river surveys are appended and are correlated with biological characteristics as represented by the Biotic Index. The principal cause of fish mortalities was de-oxygenation of river water due to prolonged ice and snow cover or to the operation of storm-sewage overflows following periods of dry weather; the first flush of water discharged from surface-water sewers after a dry period is also highly polluting and contributes to de-oxygenation. During the first few days of April each year the rivers Tame and Trent carry in suspension large quantities of detached sewage fungus which, under conditions of low flow, settle out with other suspended matter and tend to become black in colour; following rainfall and increased flow in the rivers, this material is scoured out into suspension and exerts a considerable oxygen demand thus contributing further to the de-oxygenation. The cold winter of 1963 inhibited nitrification at most of the sewage works; this caused increased concentrations of ammonia in the receiving waters at a period when flow was minimal and the frozen surface of the rivers prevented aeration, and is considered to be the cause of elimination of fish in a stretch of the river Soar. Prevention of Pollution By-laws became operative in November 1962.
W69-01510

10. SCIENTIFIC AND TECHNICAL INFORMATION

WATER RESOURCES OF VIRGINIA: AN INVENTORY OF PRINTED INFORMATION AND DATA,
Virginia Polytechnic Institute, Blacksburg.
Frederick E. McJunkin, and William R. Walker.
Water Resources Res Center Rep, Virginia Polytech Inst, Mar 1966. 109 p, 1,010 ref, append.
OWRR Project A-999-Va.

Descriptors: *Bibliographies, Water resources, Water resources research act, Water resources development, Virginia, Publications, Technology, Research and development.
Identifiers: Inventories, Technical papers, Reports.

An inventory of published information and data on the general subject of water resources in Virginia. The publication is divided into 2 basic indexes: an author index and a subject and geographic index. Publications prepared for an agency but listing individual authors have been listed under the author index. Papers prepared for agencies which do not identify the author are indexed according to agency name. Listing of authors and subjects is alphabetical. Where one author has several listings, these are chronologically ordered with a few exceptions, e.g. U S Army Corps of Engineers, wherein ordering is alphabetical by the name of the body of water concerned. An appendix enumerates addresses of state and federal government organizations concerned with research, planning, development, and use of water or water related resources in Virginia. The principal coverage has been limited largely to materials dealing wholly or in part with aspects of water resources with specific reference, geographical or otherwise, to Virginia. Some listings from related fields are also included.
W69-01231

A REVIEW OF THE LITERATURE OF 1966 ON WASTE WATER AND WATER POLLUTION CONTROL.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01514

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UNIVERSITY OF CALIFORNIA, BERKELEY

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NEW SERIES

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 2, NUMBER 5
MARCH 1, 1969

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WR 69-01594 -- WR 69-02000

NEW SERIES

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is $22.00 (domestic), $27.50 (foreign); single copy price is $3.00.

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FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION

SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 2, NUMBER 5
MARCH 1, 1969

WR 69-01594 -- WR 69-02000

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions AND Suspensions

URBIDITY MAXIMUM OF THE NORTHERN HESAPEAKE BAY,
ohns Hopkins Univ., Baltimore, Maryland, Chesapeake Bay Inst.
or primary bibliographic entry see Field 02L.
or abstract, see .
/69-01600

02. WATER CYCLE

2A. General

AKE SUPERIOR MODEL INDEPENDENT TUDY REPORT,
Visconsin Univ., Madison, Water Resources enter.
or primary bibliographic entry see Field 06A.
or abstract, see .
/69-01596

COMPENDIUM OF MAJOR INTERNATIONAL RIVERS IN THE ECAFE REGION.
nited Nations, Economic Comm for Asia and the ast, Bankok, Thailand. Div of Water Resources ev.

/ater Resources Series No 29, 75 p, 1966. 11 fig, 1 ppend, 28 ref.

escriptors: *International waters, *Data collecon, *Rivers, *Hydrologic data, River basin evelopment, Flood control, Hydroelectric power, /ater supply, Irrigation, Navigation.
entifiers: *Asia, *International rivers, Mekong, ed, Brahmaputra, Meghna, Ganges, Kosi, Gank, Gogra, Sutlej, Indus, Kabul, Helmand.

asic data are compiled for the major rivers of the ea of the Economic Commission for Asia and the ar East (United Nations). The 12 river systems overed in the compilation are the Mekong, Red, rahmaputra, Meghna, Ganges, Kosi, Gandak, ogra, Sutlej, Indus, Kabul, and Helmand. The inrmation compiled includes basic data on physical atures, hydrology, meteorology, completed procts, and planned development projects. All the vers have great potential for development of ater supplies, irrigation, power, and navigation. ney all have severe flood damage potential that ust be controlled for full development of their sins. Whenever severe floods occur in the Brahaputra and the Ganges, for example, hundreds d even thousands of lives are lost, millions are ade homeless, and crops and property damages e so great as to affect the economies of the counes as a whole. ECAFE as an international ornization can offer services to help bring about operation among riparian countries for developent projects such as the Mekong and Indus procts. (Lang-USGS)
69-01599

OAH, JOSEPH, AND OPERATIONAL YDROLOGY,
M Watson Research Center, Yorktown Heights, ew York.
enoit B. Mandelbrot, and James R. Wallis.
ater Resources Res, Vol 4, No 5, pp 909-918, ct 1968. 10 p, 21 ref.

escriptors: *Statistical models, *Hydrology, Mathematical studies, Statistics, Synthesis, Time ries analysis, Fourier analysis, Markov processes.
entifiers: Self-similar statistical models.

he use of 'self-similar' models in statistical drology appear very promising in treating the oah effect,' the observation that extreme precipitation tends to be very extreme, and the 'Joseph effect,' the observation that long periods of unusual high or low precipitation tend to be very long. Current models of statistical hydrology cannot account for either effect. Self-similarity, a statistical means of accounting for after-effects, is used to attempt to account for the empirical observations of Harold E Hurst on long term hydrological trends. The applicability of self-similar statistical models to long term hydrological records is discussed and summarized. (Knapp-USGS)
W69-01608

BASE-FLOW RECESSIONS--A REVIEW,
New Hampshire Univ., Durham.
Francis R. Hall.
Water Resources Res, Vol 4, No 5, pp 973-983, Oct 1968. 11 p, 111 ref.

Descriptors: *Recession curves, *Base flow, *Surface-groundwater relationships, Hydrograph analysis, Mathematical studies, Statistical methods.
Identifiers: Drainage basin characteristics.

The literature of base flow recession is reviewed and discussed with emphasis given to the problems and needs of current methods of study. By the early nineteen hundreds much of the basic mathematical development was completed, and some methods of hydrograph analysis were known. Recent mathematical work, although somewhat repetitive of earlier work, assesses more closely the effects of the simplifying assumptions used to obtain solutions. Most workers have preferred to follow graphical or statistical rather than mathematical approaches. The reasons appear to lie mainly in problems caused by the assumptions and in difficulties in interpreting the real stream hydrograph. Also, base flow can come from numerous sources besides ground water. Other complications arise from the question of whether the basin response is linear or nonlinear, because the response is a function of various geologic and hydrologic factors in addition to those considered in the mathematical derivations. (Knapp-USGS)
W69-01611

STATISTICAL PROPERTIES OF STREAM LENGTHS,
IBM Watson Research Center, Yorktown Heights, New York.
J. S. Smart.
Water Resources Res, Vol 4, No 5, pp 1001-1014, Oct 1968. 15 p, 8 fig, 4 tab, 17 ref.

Descriptors: *Geomorphology, *Hydrogeology, *Drainage patterns (Geologic), *Terrain analysis, Drainage density, Statistical methods, Mathematical models.
Identifiers: *Drainage basin characteristics, Stream lengths, Horton analysis, Stream numbers.

A statistical treatment of drainage basin geometry is presented and discussed. Two basic assumptions are employed in this treatment of the statistics of stream lengths: (1) All topologically distinct networks with a given number of sources are equally likely (after Shreve); (2) Lengths of interior links in a given network are independent random variables drawn from the same population. The mathematical development leads to an approximate expression for the mean length of streams of order that contains no adjustable parameters and that depends only on the stream numbers and the mean link length. This expression gives somewhat better agreement with data on actual stream systems than does Horton's law of stream lengths; other advantages over Horton's law are cited. Quantitatively, our procedure appears to account for about 65% of the variance in mean stream length data for third- and fourth-order basins. If exact values of the link numbers are introduced into the calculation, the unexplained variance is reduced to about 15%. For a complete statistical description of stream lengths, it is necessary to know the distribution of interior link lengths. Results of computer simulation studies suggest that this distribution is negative exponential. Data taken on two small watersheds (140 links) show reasonable agreement with this hypothesis.
W69-01613

HORTON'S LAWS OF STREAM LENGTHS AND DRAINAGE AREAS,
U. S. Geological Survey, Washington, D. C.
Adrian E. Scheidegger.
Water Resources Res, Vol 4, No 5, pp 1015-1021, Oct 1968. 7 p, 1 fig, 5 tab, 11 ref.

Descriptors: *Geomorphology, *Hydrogeology, *Drainage patterns (Geologic), *Streams, *Terrain analysis, Channels, Drainage density, Statistical methods, Mathematical models, Synthetic hydrology.
Identifiers: Drainage basin characteristics, Horton analysis, Stream lengths, Stream numbers, Stream orders, Drainage areas.

Horton's metric laws of stream lengths and drainage areas are examined and the validity of the concept of cycles or generations of rivers is questioned. The usual explanation of such cycles depends upon some topological features in river basins that do not seem to occur in nature. The most serious objection is that many actual stream networks are not structurally Hortonian or self-similar; that is, subnets of one generation are not necessarily topologically similar to those of other generations. It seems more likely that stream networks more closely resemble mathematical bifurcating arborescences in which the probability of branching is the same in any segement. Such networks rationally explain Horton's laws of stream lengths and drainage areas without any specific structural assumptions regarding river nets and without recourse to theories of cyclic basin development. (Knapp-USGS)
W69-01618

MINIMUM FLOW OF SMALL RIVERS IN THE ASIATIC USSR,
A. M. Vladimirov.
Translated from Trudy Gos Gidrol Inst No 139, 1967. pp 4-23. Soviet Hydrol, Selec Pap No 1, pp 1-16, 1967. 16 p, 5 fig, 3 tab, 50 ref.

Descriptors: *Base flow, *Surface-groundwater relationships, *Estimating, *Statistical methods, *Runoff forecasting, Discharge (Water), Geomorphology, Hydrogeology, Permafrost.
Identifiers: Asiatic USSR, Curve fitting, Hydrological estimation, Small rivers.

Because gaging stations are few and widely scattered in Asiatic USSR, methods for computing baseflow of small rivers by using regional hydrological parameters were developed. Graphs of the relationship between low flow and drainage basin area were plotted for 69 regions with different geomorphological and hydrogeological structures, using a 1:5,000,000 hydrogeological map. The relationship of minimum 30-day runoff (M) to basin area (F) is of the form M-F to the power n throughout most of Asiatic USSR. Base flow (Q-min) was related to the other parameters by the relation Qmin=a (F to the power n). The relation was calculated for rivers in both the warm and cold seasons. Intermittent streams were described by the relation Qmin=a ((F-C) to the power n) where C=the average area of the basin which contributes no flow. Values of the parameters for the 69 regions are tabulated. Streams in permafrost areas differ somewhat because water is stored in ice in cold weather and released in summer. The deviation of actual flow from predicted flow is 10-25% in regions with plentiful gaging data, and as high as 30% in areas with scanty data. (Knapp-USGS)
W69-01626

SMALL WATERSHED STORAGE USING LOW DAMS,
Massachusetts Univ, Amherst, Dep of Civil Engineering.
Karl N. Hendrickson.

Mass Univ, Water Resources Res Center, Symp Proc, Publication No 3, pp 141-152, June 2, 1967. 13 p, 1 map, 2 graph, 9 ref.

Descriptors: *Small watersheds, *Dam, Water management (Applied), *Design, *Project planning, Reservoir operation, Watershed management, Flood control, Water supply, Infiltration, Base flow.
Identifiers: Low dam system.

The literature of design criteria and cost-benefit analysis for construction of dams on small watersheds is reviewed and condensed for the use of local water administrators. The principles of hydrology are briefly reviewed. A detailed procedure for management and design is given. An example of a small watershed impoundment owned by the Amherst Water Board is analyzed, and the data used and the design and management decisions made are summarized. (Knapp-USGS)
W69-01636

ATMOSPHERIC CONTRIBUTIONS TO WATER QUALITY OF STREAMS IN THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE,
U. S. Geological Survey and Sears, Roebuck and Co., Chicago, Illinois, and Dartmouth College, Hanover, New Hampshire.
D. W. Fisher, A. W. Gambell, and G. E. Likens.
Water Resources Res, Vol 4, No 5, pp 1115-1126, Oct 1968. 12 p, 4 fig, 5 tab, 15 ref.

Descriptors: *Dissolved solids, *Runoff, *Precipitation (Atmospheric), Aluminum, Sulfates, Nitrates, Silica, Hydrogen ion concentration, New Hampshire.
Identifiers: Hubbard Brook Experimental Forest (New Hampshire).

The relationships between precipitation, stream discharge, and concentrations of mineral constituents of 3 tributaries of Hubbard Brook, New Hampshire, were studied. Hydrologic data and chemical analyses of precipitation and stream water were collected over a 2 yr period. It was found that precipitation supplies most of the 30-50 kg per hectare of sulfate. Input of ammonium and nitrate to the streams exceed discharge of these ions from the basin. Maximum nitrate concentrations are 2 mg/l and occur in early spring. Hydrogen ion is one of the major cations in precipitation. Bicarbonate and silica vary directly with each other and inversely with alumina. Silica discharge ranged from 20-40 kg/hectare. (Knapp-USGS)
W69-01644

PROGRESS REPORT (STUDY OF RATIONAL METHOD),
John C. Schaake, Jr.
Progress Report of the Storm Drainage Research Project, Johns Hopkins University - Report No XI.

Descriptors: *Rainfall intensity, *Storm runoff, Storm drainage.
Identifiers: *Urban drainage, *Calculations.

The observations of 19 gaged urban drainage areas was used to verify or study the Rational Method. The concentration time used was the center of mass of the rainfall hyetograph and the runoff hydrograph. The C-factor was determined by plotting frequency distributions of observed rainfall intensities and peak runoff rates on logarithmic probability paper. Equations for concentration time and 'C' factor are given provided the drainage area has certain characteristics.
W69-01894

THREE-DIMENSIONAL TYPE REPRESENTATION OF HYDROLOGICAL DATA,
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-01912

ANALYSES AND APPLICATION OF SIMPLE HYDROGRAPHS,
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01913

DISSIPATIVE RIVER FLOW MODEL,
D. R. Jackson.
J Hydrology, Vol 6, No 1, pp 33-44, Jan 1968.

Descriptors: *Model studies, Rivers, Runoff.

Derivation and solution of second order differential equation of river system is presented; model assumes routing rainfall excess through series of resistive and dissipative elements; some suggestions for fitting model to actual data are presented; comparison is made with other models.
W69-01917

RAINFALL AS AFFECTING FLOW IN SEWERAGE SYSTEMS,
C. C. Judson.
Survr, Vol 84, Nos 2168, 2169, 2170, pp 119-20, 141-3, 163-5, Aug 11, 18, and 25, 1933.

Descriptors: *Rainfall intensity, *Runoff, *Sewers, Flow measurement, Storms.

Discussion of principal rainfall factors; area of watershed, intensity of rainfall; time of concentration; area-time diagrams; methods of calculating run-off; author's method; possible economics.
W69-01919

MEASURING RAINFALL AND RUN-OFF AT ATORM-WATER INLETS,
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01923

LINEAR ANALYSIS OF RAINFALL-RUNOFF RELATIONSHIP,
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-01924

A BASIC STUDY OF THE RAINFALL EXCESS-SURFACE RUN-OFF RELATIONSHIP IN A BASIN SYSTEM,
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-01925

2B. Precipitation

A LEAST-SQUARES HYDROGRAPH ANALYSIS OF COMPLEX STORMS ON SMALL AGRICULTURAL WATERSHEDS,
Agr. Research Service, Hydrograph Lab., Beltsville, Maryland.
D. E. Overton.
Water Resources Res, Vol 4, No 5, pp 955-963, Oct 1968. 9 p, 8 fig, 2 tab, 13 ref.

Descriptors: *Unit hydrographs, *Hydrograph analysis, *Synthesis, *Storm runoff, Rainfall, Streamflow forecasting, Regression analysis, Demonstration watersheds, Maryland.
Identifiers: *Least-squares hydrograph, Storm hydrograph.

The feasibility of using a least-squares technique to extract unit hydrographs from data of complex storms on small agricultural watersheds was investigated. The procedure is the reverse of hydrograph synthesis. Rather than summing unit hydrographs to synthesize a complex storm, the unit hydrograph was calculated. The feasibility of the technique was clearly shown on four of the five Agricultural Research Service watersheds in the study. Large perturbations occurred in the calculated unit hydrographs on one of the watersheds, but reasonable results were obtained on the remaining four. The calculated unit hydrographs varied from storm to as expected. The results of these analyses demonstrate the feasibility of the least-squares technique as a means of analyzing al storm hydrographs on small agricultura watersheds to detect the nonlinearity of the rain fall-runoff process. (Knapp-USGS)
W69-01622

RESULTS OF RADAR MEASUREMENTS OF LIQUID PRECIPITATION,
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01666

REPORT OF U. S. WEATHER BUREAU STUDIES IN RADAR HYDROLOGY,
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01671

ADJUSTMENT OF RADAR ESTIMATES OF STORM MEAN RAINFALL WITH RAIN GAGE DATA,
F. A. Huff.
J Applied Meteorology, Vol 6, No 1, pp 52-6 1967.

Descriptors: *Rain gages, *Rainfall intensity Storms.
Identifiers: *Radar measurement.

Evaluation of feasibility of using surface rain gag data to modify radar-rainfall equation for specifi storm conditions; data used were for 19 storms, an study was restricted to warm-season, unstabl precipitation and to use of 10-cm radar; normal cl matic network was found inadequate for modifica tion, for area and conditions studied, if relative accurate estimate is needed; however, correspon dence of radar and rain gage patterns was muc better with 10-cm radar than it had been with 3-c radar.
W69-01673

A TIME INTERVAL DISTRIBUTION FOR EXCESSIVE RAINFALL,
H. C. S. Thom.
ASCE Proc, J of Hydr Div, Vol 85, No HY7, p 8 1959.

Descriptors: Rainfall intensity, *Sewers, *Design.

The methods usually used for frequency analysis excessive precipitation average the recurrence i tervals and thus obscure much useful informatio for the design of sewerage systems. Additional i formation can be obtained however by relati probability to recurrence interval instead of rainfa depth, thus giving the distribution of recurrence i terval for a predetermined amount of rainfall.
W69-01898

CITY OF OAKLAND DEVELOPS NEW RAINFALL INTENSITY-DURATION CURVES,
D. M. Winton.
Pub Works, Vol 90, No 7, p 120, 1960.

Descriptors: *Rainfall intensity, Design.
Identifiers: *Storm sewers, *Calculations, Oakla (Calif).

Based on a report compiled by Fites, L. A., t author gives a brief account, with tables a graphs, of the 1958 rainfall intensity-durati curves now being used in the city of Oaklan Calif., for the design of storm sewers.
W69-01908

RAINSTORMS MADE TO ORDER,
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-01914

SPATIAL DISTRIBUTION OF HEAVY STORM RAINFALLS IN ILLINOIS,
F. A. Huff.
Water Resources Res, Vol 4, No 1, pp 47-54, Feb 1968.

Descriptors: *Storms, Rainfall intensity.
Identifiers: *Calculations, Illinois.

An 11-year continuous record from 49 recording rain gages on 400 square miles in central Illinois has been used to derive characteristic area-depth relations in heavy rainstorms for storm periods of 30 minutes to 48 hours on areas of 50, 100, 200, and 400 square miles. First, eight general equations were statistically tested to determine the most appropriate fitting method for the area-depth curve. Over-all, an equation relating rainfall depth to the square root of the area received the highest score. However, the equation that fit best was found to vary with areal size, mean rainfall, and storm duration, which, in turn, reflected general trends in relative variability and skewness of the rainfall spatial distribution. Because of the high degree of variability in the area-depth relation between storms, the analytical results have been presented as probability distributions for given sets of conditions with respect to area, storm duration, and rainfall volume. Thus, the user is provided with both average curves and curves applicable to more extreme patterns of storm rainfall.
W69-01915

TIME DISTRIBUTION OF RAINFALL IN HEAVY STORMS,
F. A. Huff.
Water Resources Res, Vol 3, No 4, p 1007, 1967.

Descriptors: *Storms, Rainfall intensity.
Identifiers: *Calculations, Illinois.

Time distribution relations have been developed for heavy storms on areas ranging up to 400 square miles and presented in probability terms to provide quantitative information on interstorm variability and to provide average and extreme relations for various applications of the findings. It was found that the relations could be represented best by relating per cent of storm rainfall to per cent of total storm time and grouping the data according to the quartile in which rainfall was heaviest. The individual effects of mean rainfall, storm duration, and other storm factors were small and erratic in behavior when the foregoing analytical technique was used. Basin area had a small but consistent effect upon the time distribution. The derived relations are applicable to the Midwest and other areas of similar climate and topography. They can be used in conjunction with published information on spatial distributions and other storm parameters to construct storm models for hydrologic applications.
W69-01916

2C. Snow, Ice, AND Frost

SNOWMELT AT AN INDEX PLOT,
New Brunswick Univ., Fredericton, N. B., Canada.
W. W. Pysklywec, K. S. Davar, and D. I. Bray.
Water Resources Res, Vol 4, No 5, pp 937-946, Oct. 1968. 8 p, 5 fig, 1 tab, 7 ref.

Descriptors: *Snowmelt, *Runoff forecasting, Heat budget, *Regression analysis, Water yield, Meteorological data.
Identifiers: Canada, New Brunswick, Snowmelt index plot.

A large experimental index plot was installed in an open area near a climatological station in the North Ashwaaksis Stream Basin, N B, to obtain data for relation between snowmelt measured at the plot and regional meteorological parameters related to the snowmelt process. The data collected during the 1966 spring snowmelt season were analyzed by the degree-day method, the U S Corps of Engineers generalized snowmelt equations, and optimal regression equations derived from the measured snowmelt at the index plot and related thermal budget indices calculated using individual meteorological parameters. The methods gave generally comparable results; their specific merits and limitations are discussed. The deviation of seasonal totals by the three methods varied from -15.6 to +54.5%. The relative accuracy of the three techniques as daily predictors compared by taking the root-mean-squared values of the deviations of daily estimated snowmelt from the daily measured values ranged from 0.17 to 0.22 in. It is suggested that experimental index snowmelt plots and optimal regression equations may enable dependable prediction of point snowmelt rates to use for estimation of basin-wide snowmelt and hydrograph synthesis. (Knapp-USGS)
W69-01597

ALBEDO OF INTERCEPTED SNOW,
Northeastern Forest Experiment Station and Syracuse Univ., College of Forestry, Syracuse, New York.
For primary bibliographic entry see Field 02I.
For abstract, see .
W69-01598

PRINCIPAL HEIGHT ZONES OF STREAMFLOW FORMATION IN CENTRAL ASIA IN DIFFERENT MONTHS OF THE GROWING SEASON,
T. S. Abal'yan.
Soviet Hydrol, Selec Pap No 1, pp 72-81, 1967. 10 p, 2 fig, 3 tab, 17 ref.

Descriptors: *Streamflow forecasting, *Snow surveys, *Snowmelt, Runoff forecasting, Water supply, Synoptic analysis, Hydrologic properties, Meteorological data.
Identifiers: USSR, Central Asia, Streamflow formation.

The altitude zones providing meltwater runoff for each month in the growing season of central Asia, USSR, were determined by multiple correlation analysis of runoff and snow survey data. Streamflow forecasting in Central Asia, which has extremely uneven climatic, hydrologic, and other physiographic characteristics, is possible with the assumption that climatic variation in the mountains has a well defined pattern related to altitude. Regression analysis is used to determine whether the character of variation of snowpack with altitude, heat flux distribution and precipitation vary between drainage basins in a region. Monthly discharge data for 43 rivers in Central Asia were collected and tabulated, monthly discharges were correlated with the areas of altitude zones where snowmelt occurs each month and the results were tabulated. Runoff and elevations were plotted and interpretation of the graph provides the amount of runoff for each altitude zone. The analysis facilitates streamflow forecasting by snow surveying. (Knapp-USGS)
W69-01601

METHOD OF FORECASTING ICE PHENOMENA IN RIVERS,
Hydrometeorological Scientific Research Center, USSR.
N. A. Bagrov, and A. P. Kukhto.
Trans. from Meteorol i Gidrol, No 2, 1967, pp 22-28. Soviet Hydrol, Selec Pap No 1, pp 97-102, 1967. 6 p, 1 fig, 2 tab, 5 ref.

Descriptors: *Freezing, *Rivers, *Forecasting, *Synoptic analysis, Climatology, Charts, Meteorology, Regions, Regression analysis.
Identifiers: *Ice phenomena, USSR.

Methods for predicting freezing of rivers in the USSR using atmospheric circulation and thermal budget data over very broad regions are discussed. Because initial autumn heat contents of rivers are much less variable than cooling-season weather, dates of ice formation are determined chiefly by the cooling history of the water. Multiple regression analysis is used to determine the effectiveness of predictors chosen by techniques of synoptic analysis in predicting data of freezing. (Knapp-USGS)
W69-01602

DISTRIBUTION OF THE WEIGHT OF SNOW COVER IN THE USSR,
V. I. Kipovskaya.
Translation from Gl Geofiz Observ No 210, 1967. pp 68-78. Soviet Hydrol, Selec Pap No 1, pp 63-72, 1967. 10 p, 5 fig, 5 tab, 7 ref.

Descriptors: *Snow cover, *Snow surveys, *Water equivalent, Synoptic analysis, Data collections, Frequency, Maps, Meteorological data.
Identifiers: USSR, Snow accumulation, Applied climatology.

Snow survey data for the USSR from 1936 to 1960 from 700 stations were analyzed for water equivalent and snow depth. Maps of the water equivalent of snow accumulations of 50, 20, 10, and 5% probability were compiled. The water equivalent of snow varies greatly in the USSR. The highest coefficients of variation are in the Ukraine (0.51), Belorussia (0.57), the Baltic States (0.60), Maritime Province (0.57), and Krasnodar Province (0.71), all areas of unstable snow cover; the lowest are in areas of stable accumulation. Water equivalents are higher in forested than in open areas. (Knapp-USGS)
W69-01631

2D. Evaporation and Transpiration

PATTERNS OF THE THERMAL REGIME OF THE SURFACE LAYER OF WATER,
M. P. Timofeyev, and S. P. Malevskiy-Malevich.
Translation from Meteorol i Gidrol, No 2, 1967, pp 57-65. Soviet Hydrol, Selec Pap No 1, pp 102-109, 1967. 8 p, 2 fig, 6 tab, 14 ref.

Descriptors: *Air-Water interfaces, *Heat budget, *Heat transfer, *Thermal stratification, *Bodies of water, Evaporation, Convection, Radiation, Winds, Waves (Water).
Identifiers: *Heat exchange, *Thermal regime, USSR, Lake Baikal, Lake Sevan.

The processes of heat exchange between water surface and overlying air are reviewed and examples calculated for Lake Baikal, the North Atlantic Ocean, Lake Sevan, and an evaporation pan. Results of measurements of the water temperature at various depth, wave height, wind velocity, air temperature, and radiation balance were compared with calculated values. The main forms of heat exchange between the water surface and the atmosphere are known to be turbulent exchange of sensible heat, radiation, and heat exchange associated with phase changes of water (mainly evaporation). These forms of heat exchange depend strongly on the characteristics of the thin surface layer of water, mainly on its temperature and that of the adjacent air layer. But the temperature of the thin surface layer of water, which affects the different forms of heat exchange, is independent on the direct influence of solar radiation, since absorption of radiation in a thin layer is negligibly small. The results testify to the fact that under normal conditions, except during severe storms for which data are lacking, the temperature gradient in the upper layer of water remains negative. (Knapp-USGS)
W69-01604

THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL CONDITIONS,
Vanderbilt Univ., Nashville, Tenn; Office of the Surgeon, Headquarters, U. S. Army Vietnam; and Johns Hopkins Univ., Baltimore, Maryland.

John E. Edinger, David W. Duttweiler, and John C. Geyer.
Water Resources Res, Vol 4, No 5, pp 1137-1143, Oct 1968. 7 p, 2 tab, 10 ref.

Descriptors: *Heat budget, *Surface waters, Heat balance, Temperature, Evaporation, Convection, Radiation, Meteorology, Air-water interfaces.
Identifiers: Surface temperature, Equilbrium temperature.

The calculation of heat exchange across air-water interfaces, one of the most important processes involved in thermal regimes of water bodies, is reviewed and discussed. The net heat exchange is the sum of the energy interchange by radiation, evaporation, and conduction between the water and air. Observable meteorological variables are used to calculate the thermal exchange coefficient and equilibrium temperature, which are used together to calculate net heat exchange. Many mathematical formulas and descriptions are available for use in thermal balance calculation. Temperature distributions within water bodies may be calculated in some relatively simple cases. Heat exchange calculations are necessary in predicting evaporation from proposed storage facilities. (Knapp-USGS)
W69-01642

2E. Streamflow and Runoff

INTRA-ANNUAL DISTRIBUTION OF SUBTERRANEAN FLOW INTO RIVERS,
T. M. Chernaya.
Soviet Hydrol, Selec Pap No 1, pp 25-41, 1967. 17 p, 4 tab, 4 ref, 1 append.

Descriptors: *Surface-groundwater relationships, *Bank storage, *Groundwater movement, Discharge (Water), Base flow, Streamflow, Statistical methods, Data collections, Hydrogeology, Permafrost.
Identifiers: USSR, Physiographic controls, Subterranean flow.

Groundwater flow into rivers of the USSR is analyzed and discussed, using data from a collection made in compiling a map of groundwater flow for the USSR. Groundwater discharge has significant annual low and high flow periods. Periods of high discharge from alluvium generally last one season, usually spring, in the plains and generally 3 seasons, spring through autum, in permafrost regions. Low alluvial flow lasts one season in warm areas and may be zero in permafrost regions. Flows for 39 rivers are tabulated. Preliminary results of a statistical analysis of the relation of groundwater discharge to physiographic parameters are presented in tables. In addition to problems concerning methods of computing intra-annual distribution of subsurface flow, an examination is made of results of an analysis of distribution patterns under various physiographic conditions. (Knapp-USGS)
W69-01603

INVESTIGATION OF THE STABILITY OF SOME EXPLICIT DIFFERENCE SCHEMES IN THE INTEGRATION OF SAINT-VENANT EQUATIONS,
Hydrometeorological Scientific Research Center, USSR.
V. I. Koren.
Translation from Meteorology and Hydrology, Meteorol i Gidrol, No 1, 1967, pp 42-48. Soviet Hydrol, Selec Pap No 1, pp 91-97, 1967. 7 p, 4 ref.

Descriptors: *Hydraulics, *Unsteady flow, *Mathematical studies, Flow rates, Velocity, Equations, Analytical techniques, Numberical analysis.
Identifiers: *Saint-Venant equations, Stability criteria.

To determine the possibility of extending the stability criteria obtained to nonlinear equations, numerical experiments were performed for a broad range of variation of initial and boundary conditions. Computations of the unsteady motion of water in rivers are based on the integration of a system of Saint-Venant equations. Numerical methods are given and mathematical solutions are presented. (Lang-USGS)
W69-01605

METHOD OF DETERMINING THE EFFECTIVENESS OF HYDROLOGIC FORECASTS IN ESTABLISHING THE OPERATING CONDITIONS OF HYDROELECTRIC POWER PLANTS,
S. B. Yelakhovskiy.
Soviet Hydrol, Selec Pap No 1, pp 81-90, 1967. 10 p, 4 fig, 7 ref.

Descriptors: *Statistical methods, *Routing, Hydroelectric plants, Stochastic processes, Systems analysis, Mathematical studies, Management.
Identifiers: *Hydrologic forecasts, USSR, Volga River.

Principals for establishing the operating conditions of hydroelectric power plants are described. The effectiveness of several methods of predicting inflow to reservoirs used for electric power generation in the USSR is examined. For short term predictions of a year or less, hydrographs, routing methods, and other deterministic methods are highly accurate. For long term prediction, only probabilistic methods are reasonably reliable. Graphs and mathematical equations are presented. The method used to evaluate forecast effectiveness is illustrated by sample calculations for the Lenin Hydroelectric Power Plant on the Volga. (Knapp-USGS)
W69-01606

FLOOD SURGE ON THE RUBICON RIVER, CALIFORNIA--HYDROLOGY, HYDRAULICS AND BOULDER TRANSPORT,
U S Geological Survey, Washington, D. C.
Kevin M. Scott, and George C. Gravlee, Jr.
U S Geol Surv Prof Pap 422-M, pp M1-M40, 1968, 40 p, 33 fig, 5 tab, 34 ref.

Descriptors: *Floods, *Dam failure, *Surges, *Geomorphology, Erosion, Sediment transport, Sedimentology, Deposition (Sediments), California, Historic flood.
Identifiers: *Torrential rainfall, *Hell Hole Dam, Rubicon River (California).

The sedimentologic and geomorphic effects of a single catastrophic flow, caused by the failure of the Hell Hole Dam on the Rubicon River, in the Sierra Nevada, California on Dec 23, 1964, are documented. Extensive erosion of outwash terraces indicates a flow probably greater than any post-Pleistocene discharge. A rainfall of 22 in. in the 5 days preceeding the failure produced record peak discharges. The surge discharges were greater than the previous record along the entire 61 miles route downstream, including the Rubicon, Middle Fork American, and North Fort American Rivers. As far as 36 miles downstream, flows were still 3.3 times the 100 yr flood. Average flood wave velocity was 22 fps. The diorite rockfill in the dam acted as a tracer; particles of fill moved no farther than 2.1 miles, and rounding of particles took place within 1.5 miles. Intense local erosion initiated many landslides and other lateral sources of sediment. It is concluded that catastrophic floods may strongly influence mountain stream morphology without much effect on total sediment transport. They may modify bed patterns, cause cycles of increased mass movement, cause mass flow of coarse detritus in the channel, and cause extensive lateral supply of extremely coarse sediment. Flood debris is later dispersed by lower flows acting with weathering in place. (Knapp-USGS)
W69-01610

BASE-FLOW RECESSIONS--A REVIEW,
New Hampshire Univ., Durham.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01611

SOME FACTORS AFFECTING BASEFLOW,
Illinois State Water Survey, Urbana.
Krishan P. Singh.
Water Resources Res, Vol 4, No 5, pp 985-999, Oct 1968. 15 p, 8 fig, 15 ref.

Descriptors: *Base flow, *Recression curves, *Hydrograph analysis, Groundwater movement, Surface-groundwater relationships, Mathematical studies, Statistical methods, Evapotranspiration, Aquifers, Recharge.
Identifiers: Boussinesq equations.

Recession curves of stream-aquifer systems are analyzed and discussed in connection with problems of streamflow regulation for pollution control, farming practice evaluation, locating suitable areas for induced infiltration, and estimating the increase in baseflow from infiltration. For a shallow aquifer and a fully penetrating stream, the ideal baseflow curve may not be plotted as a straight line on semilog paper, and its recession rate continuously decreases with time. For a deep aquifer and a shallow-entrenched stream, the ideal base-flow generally decays exponentially, and its recession rate decreases with increasing stream entrenchment. In the case of loss from evapotranspiration, the baseflow curves steepen progressively with time, and the stream may become influent. In the case of gain from confined aquifers, the baseflow curves become flatter. The recharge results in shifting of the baseflow curves upward in magnitude or laterally in time. The baseflow peak occurs at about 0.75T from the beginning of recharge to the aquifer, where T denotes the effective duration of recharge. The lag between the total flow peak and the baseflow peak depends on rainfall, soil, and basin factors. The variability of these factors precludes the notion of a constant lag. (Knapp-USGS)
W69-01612

STATISTICAL PROPERTIES OF STREAM LENGTHS,
IBM Watson Research Center, Yorktown Heights, New York.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01613

COMPREHENSIVE BASIN STUDY SABINE RIVER AND TRIBUTARIES, TEXAS AND LOUISIANA.
Corps of Engineers, Fort Worth District.

Main Rep, Vol 1, Comp Basin Study, 183 p, Dec 1967. 4 fig, 10 plate, 28 tab, 5 append.

Descriptors: *Data collections, *River Basin Development, Flood control, Land management, Water supply, Watershed management, Transportation, Navigation, Recreation facilities, Texas, Louisiana, Water utilization.
Identifiers: *Sabine River Basin (Texas-Louisiana), Comprehensive planning.

A comprehensive study of the water resources, including recreational potential, hydroelectric power potential, and need for flood control of the Sabine River Basin, Texas and Louisiana, was made by the U S Army Corps of Engineers, U S Departments of Agriculture, Commerce, Health Education and Welfare, Interior, Federal Power Commission, and the States of Louisiana and Texas. The Sabine basin has major floods of long duration and frequent smaller floods. There are no major flood control improvements. Because channel capacities are inadequate, flood release channels are recommended. Water demands were projected to 2075. Both quantity and quality of water need to be adequate to meet projected demand. Recommen

dations for improvements include 3 major reservoirs at Mincola, Lake Fork, and Big Sandy, Greenville flood protection works, a navigation project from Echo to Pruitt Bluff, and 11 upstream watershed improvement projects. Estimated total construction cost is $191,143,000 with $1,684,600 annual cost. The benefit-cost ratio is 1.6 to 1. (Knapp-USGS)
W69-01617

HORTON'S LAWS OF STREAM LENGTHS AND DRAINAGE AREAS,
U. S. Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01618

WATERSHED SIMULATION BY STREAM PATH ANALOGY,
Agricultural Research Service Hydrograph Lab., Beltsville, Maryland.
C. A. Onstad, and D. L. Brakensiek.
Water Resources Res, Vol 4, No 5, pp 965-971, Oct 1968. 7 p, 3 fig, 2 tab, 12 ref.

Descriptors: *Hydrographs, *Routing, *Runoff forecasting, *Synthetic hydrology, Overland flow, Flow nets, Model studies, Simulation analysis, Watersheds (Basins).
Identifiers: Watershed models.

A model is proposed by which an outflow hydrograph is synthesized by routing input through a simulated drainage system. The simulated flow system is developed from a flow net. Overland flow is routed through paths defined by pairs of stream lines constructed normal to the contour lines (equipotentials) of the watershed, terminating at intersections with definite surface channels. Channel flood routing is then performed down to the basin outlet, with the calculated overland flow from each flow path as lateral input. Optimization of the system parameters is studied with respect of factors calculated from hydrograph moments. By comparison with visual judgments the hydrograph lag and shape factor were found to be possible criteria for optimization. (Knapp-USGS)
W69-01621

MAPS OF MINIMUM STREAMFLOW IN THE ASIATIC USSR,
V. A. Baranov, Z. I. Petersen, and L. N. Popov.
Translation from Trudy Gos Gidrol Inst No. 139, 1967, pp 24-35. Soviet Hydrol, Selec Pap No 1, pp 16-25, 1967. 10 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Data collections, *Low flow, *Base flow, *Hydrogeology, *Maps contours, Discharge (Water), Permafrost.
Identifiers: Asiatic USSR, Low-flow estimation.

A description is given of the distribution characteristics of minimum streamflow in Asiatic USSR. Minimum average monthly summer and winter runoffs are presented in 2 isoflow contour maps. Runoff characteristics for the Urals, West Siberian lowland, Kazakh folded country, Central Siberian highland, Altai and Sayan Mountains, Transbaikalia, Northeast Siberia, Far East Siberia, Sakhalin, and Kamchatka are described briefly. Flows and variability of flow are tabulated for 36 sub-regions. No account was taken of data on rivers regulated by lakes or reservoirs. The maps were compiled from field observations and from conversion factors. Data used in the compilation were collected at 3,955 hydrological stations between 1959 and 1966. (Lang-USGS)
W69-01628

THE GRAND RIVER AND ITS PLUME IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor, Great Lakes Res Div, Inst of Science and Tech.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-01651

LABORATORY STUDIES OF STORM OVERFLOWS WITH UNSTEADY FLOW,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01679

HYDRAULIC BEHAVIOR OF STORM WATER INLETS,
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01704

STORM-WATER OVERFLOWS FROM COMBINED SEWERS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01726

DETERMINATION OF VARIABLE MAXIMAL INTENSITY COEFFICIENTS FOR STORM-SEWER CALCULATIONS,
L. T. Epshtien.
Vosdsn Sanit Tekh, No 5, p 15, 1960.

Descriptors: *Rainfall intensity, *Rainfall-runoff relationships, Design, Storm runoff.
Identifiers: *Storm sewers.

The author discusses a method for determining the coefficient of variable maximal intensities, or relative reduction in run-off intensities for individual collectors, for use in designing storm-water sewers.
W69-01780

HOW TO ESTIMATE STORM WATER QUANTITIES,
H. M. Gifft, and G. E. Symons.
Water and Wastes Eng, Vol 5, No 3, pp 46-50, March 1968.

Descriptors: *Storm runoff, *Rainfall intensity, Design, Drainage.
Identifiers: *Storm sewers, *Capacity, Calculations.

Several factors involved in determining quantities of storm water are discussed for storm sewer design as related to rainfall and runoff; derivation of formulas for calculation of drainage area shape, rainfall intensity-frequency data, time of concentration, and co-efficient of runoff; nomograph for determining inlet time of flow.
W69-01785

A METHOD OF COMPUTING URBAN RUNOFF,
W. I. Hicks.
ASCE Proc, Vol 109, 1217, 1944.

Descriptors: Hydraulics, *Rainfall-runoff relationships, *Hydrographs, *Runoff forecasting.
Identifiers: *Urban drainage.

The author presents results of hydraulic investigations and rainfall - runoff gagings and develops hydrographs for different sized areas, with varyiing degrees of development and time of concentration.
W69-01884

STORM RUN-OFF FROM URBAN AREAS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01886

DETERMINATION OF RUN-OFF COEFFICIENTS,
F. W. MacDonald, and A. Mehn.
Pub Works, Vol 94, No 11, p 74, 1963.

Descriptors: Drainage system, *Land use, *Runoff.
Identifiers: Surface permeability, *Urban drainage, *New Orleans (La).

Results of a study to determine times of concentration and obtain an accurate value for the coefficient of imperviousness of one of the large drainage districts of the city of New Orleans, La., carried out in cooperation with the Sewerage and Water Board, are summarized in Tables and discussed. Results indicate that the coefficient for built-up areas, which comprise over 4000 acres in the district is 0.548 whereas the coefficient for a typical suburban area is 0.455; the coefficient for the entire drainage district is 0.559. The Rational formula was employed to determine run-off coefficients using a 79-minute time of concentration, and the average value obtained was 0.653, this value being within the ranges recommended for combined residential and commercial areas.
W69-01889

FLOODING FREQUENCIES FOR URBAN DRAINAGE DESIGN,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01893

STUDIES OF SEVERE RAINSTORMS IN ILLINOIS,
G. E. Stout, and F. A. Huff.
ASCE Proc, J of Hydr Div, Vol 88, No HY4, p 129, July 1962.

Descriptors: *Rain gages, Watersheds, *Storms.
Identifiers: Urban drainage.

Study included a network of 10 recording rain gauges on a 10 sq mi urban area and investigated distribution characteristics of heavy rainstorms over urban watersheds for 10 year period. It was found (1) twice as many excessive quantities occur within a 10 mi2 area compared with a specific point within area; (2) the percent of the 10 mi2 area experiencing excessive rainfall increases with increasing storm duration; (3) majority of the excessive quantities of rainfall lasting from 30 to 24 hr occur in the same storms; (4) although a single rain gage records only a portion of the excessive rate occurrences in 10 mi2, a point rainfall record is satisfactory index of frequency distribution of areal mean rainfall; (5) urban influences, if present, are not of practical significance in the distribution of excessive quantities.
W69-01896

PROBLEMS OF WATER DISCHARGE IN URBAN AREAS,
F. B. Veldkamp.
Commissie voor Hydrologisch Onderzoek T N O-Verslagen en Mededelingen, No 9-Verslag van de Technische Bljeenkomst, No 18, pp 73-94, 1963.

Descriptors: *Discharge (Water), *Rainfall-runoff relationships, *Storm runoff.
Identifiers: *Surface permeability, *Urban hydrology, Urban drainage.

Problems of water discharge in urban areas; discharge is calculated from rainfall and runoff from area of roofs, street and sidewalk surfacings, and backyards connected to sewer system; runoff is assumed to be 100%; storage basins are calculated from storms with frequency lower than once every year.
W69-01899

RUNOFF ESTIMATION FOR VERY SMALL DRAINAGE AREAS,
Warren Viessman.
Water Resources Res, Vol 4, No 1, pp 87-94, Feb 1068.

Descriptors: *Storm runoff, *Hydrographs, *Runoff forecasting, Rainfall-runoff relationships.
Identifiers: *Urban hydrology.

Analyses of hydrologic data from high-intensity short-duration storms on very small drainage areas

having varying physical characteristics indicated that a 1-minute unit hydrograph could be used as the basis for generating runoff from an effective rainstorm input. The single parameter of the unit hydrograph (time constant K) was shown to be related to the physical characteristics of the drainage area. No evidence of the correlation between K and the storm pattern was discovered. Procedures are given for estimating net storm inputs.
W69-01900

THE HYDROLOGY OF SMALL IMPERVIOUS AREAS,
W. Viessman.
Water Resour Res, Vol 2, pp 405-412, 1966.

Descriptors: *Storm runoff, *Hydrographs, Rainfall-runoff relationships.
Identifiers: *Urban drainage, *Urban hydrology, Surface permeability.

A method for computing storm-water run-off from small, impervious, urban areas is described in which consecutive 1-minute unit hydrographs are determined for a storm and summed to provide a total outflow hydrograph. Calculations are based on the assumption that such areas behave as linear reservoirs and take account of the drainage-area lag time and losses due to depression storage. Good agreement was obtained between actual and computed hydrographs, and peak discharges for 30 storms were predicted with an average absolute error of 9 per cent.
W69-01901

PROGRESS REPORT ON THE STORM DRAINAGE RESEARCH PROJECT, JULY 1, 1958, TO JUNE 30, 1959,
Johns Hopkins Univ., Dept. Sanit. Eng. Water Resour., Baltimore.
W. Viessman.

Descriptors: *Storm drainage, *Runoff forecasting, Storm runoff, Hydraulics, *Intakes, *Design, *Rain gages, *Weirs, *Flow measurement, *Instrumentation, *Rainfall-runoff relationships, *Rainfall intensity.
Identifiers: *Urban hydrology, *Urban drainage.

In 1949, a research project was initiated in Baltimore, Md., to solve problems connected with urban storm drainage, including the development of a reliable method for predicting storm water runoff. In the first 7 years, the hydraulic characteristics of storm water inlets were investigated, and on the basis of the results, the design of such inlets was modified, a very efficient square grate was designed, and a method was provided for matching the inlet capacity with the drain capacity. New instruments have been developed for measuring and recording rainfall and storm run-off, including a special weir for measuring flows into storm water inlets, and a pressure-type depth-recording system. At present, studies are being carried out on the hydrological relations between rainfall and urban run-off. On the basis of measurements of rainfall and run-off over a period of 4 years, it was concluded that the Rational Method used in designing urban storm drainage systems gives unreliable estimates of the peak rate of run-off, and a new method of design, known as the Inlet method, was developed. This method is based on the maximum 5-minute rainfall intensity at each inlet, and a study has therefore been made of the relation between maximum and short-interval rainfall intensity and the duration of the intense part of a storm. Studies are also in progress to determine the range of applicability and statistical validity of the new method, the effect of antecedent rainfall on the peak discharge for a drainage area, and the timing and attenuation of storm water flows in closed drainage systems.
W69-01902

HYDROLOGIC EFFECTS OF URBAN GROWTH--SOME CHARACTERISTICS OF URBAN RUN-OFF,
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-01903

THE DESIGN OF URBAN SEWER SYSTEMS. RESEARCH INTO THE RELATION BETWEEN RATE OF RAINFALL AND THE RATE OF FLOW IN SEWERS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01905

TIME IN URBAN HYDROLOGY,
For primary bibliographic entry see Field 04D.
For abstract, see .
W69-01906

PRELIMINARY STUDY OF EFFECT OF URBANIZATION ON FLOODS IN JACKSON, MISSISSIPPI,
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-01907

A METHOD OF URBAN DRAINAGE DESIGN FOR REGIONS OF HIGH RAINFALL INTENSITY,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01910

HARVARD GULCH FLOOD CONTROL PROJECT,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01911

CALCULATION OF DISCHARGE OF RAIN DITCHES AND RAINFALL COLLECTING SYSTEMS,
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-01918

RAINFALL AS AFFECTING FLOW IN SEWERAGE SYSTEMS,
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01919

RETARDATION OF DISCHARGE IN PUBLIC WATERS WITHIN THE AREA OF A COMMUNITY,
W. Kadner.
Gas-Wasserfach, Vol 109, No 6, pp 158-159, 1968.

Descriptors: *Storm runoff, *Overflow, *Rainfall-runoff relationships, Design, *Drainage systems.
Identifiers: *Combined sewers, *Storm sewers, Urban drainage.

Public waters often serve as the unloading place for rainwater overflows of mixed sewer systems or rainwater mains of separate systems. In sizing such streams, it is difficult to follow the usual corresponding methods for town drainage and Kehr's rainwater run-off diagram does not permit the determination of maximum run-off any more. It is claimed that the method described has the advantage of permitting the determination of run-off at any point in the stream and thus, also, of the respective design flow. Moreover, it makes it possible to add new drainage areas and to determine the volume of the permissible maximum amount and to make corrections for the developed progress line without too much effort.
W69-01920

CONTRIBUTION TO THE DETERMINATION OF THE DIMENSIONS OF RAIN STORAGE TANKS,
W. Kadner.
Gesundheits-Ing, Vol 88, pp 124-127, 1967.

Descriptors: Rainfall intensity, *Storm runoff.
Identifiers: *Combined sewers, *Storage tanks, *Capacity, *Calculations.

The author compares two methods, the Muller-Neuhaus and the Randolf, for the determination of suitable dimensions for storm-water storage tanks in combined sewerage systems. He stresses the importance of determining a progression from observations of rainfall in the place concerned and of referring to this in the calculations; those made for the town of Karlsruhe, Germany, are given as an example, with tables and graphs. No significant difference was found between the results obtained by the two methods, but the Randolf method is more suitable when a series of tanks is to be used.
W69-01921

HYDROLOGICAL AND EFFICIENCY INVESTIGATION METHOD IN CONNECTION WITH ESTABLISHMENT OF DEVELOPMENT RATE OF SURFACE DRAINAGE,
G. Kienitz.
Int Commission on Irrigation and Drainage-5th Cong, Tokyo-Trans, Vol 3, pp 15.495-504, 1963.

Descriptors: *Drainage systems, Rainfall-runoff relationships, Discharge (Water).
Identifiers: *Capacity.

Investigations were carried out to establish what channel flood-waves would develop in catchment areas as result of precipitation, depending on discharge capacity of drainage system.
W69-01922

2F. Groundwater

INTRA-ANNUAL DISTRIBUTION OF SUBTERRANEAN FLOW INTO RIVERS,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01603

SOME FACTORS AFFECTING BASEFLOW,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01612

ROLE OF A GULLY-RAVINE NETWORK IN THE FEEDING OF GROUND WATER AND METHOD OF DETERMINING ITS AREAS,
B. S. Ustyuzhanin.
Translation from Trudy Gos Gidrol Inst No. 139, 1967. pp 224-232. Soviet Hydrol, Selec Pap No 1, pp 56-63, 1967. 8 p, 4 fig, 2 tab, 17 ref.

Descriptors: *Groundwater recharge, *Infiltration, *Snowmelt, *Gullies, *Ravines, *Ephemeral streams, Maps, Estimating, Snow cover, Intermittent streams.
Identifiers: *Water balance studies, USSR, Snowmelt infiltration.

Investigations conducted in various parts of the European USSR show that groundwater recharge through a network of ephemeral streams in ravines, gulches, and gullies, reduces meltwater runoff in spring. Snow is blown off flat areas and collects in ravines, where it protects the ground from freezing. When the snow melts, infiltration occurs first and most rapidly in ravine bottoms where the soil is not frozen as deeply as on the flats. The ratio of snow-filled ravines to bare uplands is not easily determined from presently available topographic maps but may be estimated from agricultural use maps with plowed-area information, because plowing is done only on upland flats. Ravines occupy from about 9-25% of the surface area in the regions stu

died. Conversion factors relating ravine network length to area covered for several regions of USSR are tabulated to aid in estimating ravine area where no agricultural use maps are available. (Knapp-USGS)
W69-01630

GROUND-WATER LEVELS IN THE UNITED STATES 1961-65--SOUTHWESTERN STATES.
U. S. Geological Survey, Washington, D. C.

U S Geol Surv Water-Supply Pap 1855, 125 p, 1968.

Descriptors: *Data collections, *Water wells, *Water levels, Water level fluctuations, Observation wells, Arizona, California, Hawaii, Nevada, New Mexico.
Identifiers: Periodic observations.

Water-level data from a network of observation wells in the southwestern U. S. and Hawaii taken between 1961-65 are tabulated. The network of wells in each state is briefly described. Well descriptions, dates of measurement, and water levels are tabulated. A map shows well locations for each state. (Knapp-USGS)
W69-01632

TURBULENT FLOW IN POROUS MEDIA,
Melbourne Univ., Australia, and Water Res Foundation of Australia.
C. E. Kirkham.
Water Res Found of Australia Bull No 11, 146 p, Sept 1967. 6 tab, 31 fig, 94 ref, append.

Descriptors: *Turbulent flow, *Porous media, *Computer programs, Laplaces equation, Darcys law, Reynolds number, Model studies, Mathematical models, Digital computers, Analytical techniques.
Identifiers: Australia, Experimental Model study.

Turbulent flow in porous media was studied by numerical, model and analog methods to develop a field equation suitable for all porous media flow. Energy loss equations for various types of media were determined and methods of analysis were developed and applied to flow fields such as groundwater flow to wells, flow through and over rockfill banks, and confined flow through right angled bends and sectors. The general equation is applicable to laminar, turbulent or transition flows. Analytical solutions of the equation are presented for simple boundary conditions and compared with solutions using Laplace's equation to illustrate the inaccuracy of the Laplace method when Darcy's law is not obeyed. For complicated boundaries, a digital computer program for IBM 7044 is presented and a FORTAN listing is included. The equation was verified with a model study. The model was a gravel-filled 90 deg miter bend with unequally long and wide legs. (Knapp-USGS)
W69-01648

AQUIFER RECHARGING,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01826

2G. Water in Soils

STEADY INFILTRATION FROM BURIED POINT SOURCES AND SPHERICAL CAVITIES,
CSIRO Division of Plant Industry, Canberra, Australia.
J. R. Philip.
Water Resources Vol 4, No 5, pp 1039-1047, Oct 1968. 9 p, 6 fig, 15 ref.

Descriptors: *Infiltration, *Unsaturated flow, *Porous media, *Mathematical studies, Soil moisture, Hydraulic conductivity, Capillary conductivity, Darcys law, Diffusion.
Identifiers: Point source infiltration, Spherical cavity source infiltration, Quasilinearization.

An analysis is given of unsaturated flow regimes of prolonged infiltration into regions of deep water table from point sources and from spherical cavities. The analysis is simplified by assuming that it does not involve a free surface. Hydraulic conductivity is represented by an exponential function of moisture potential and the nonlinear steady flow equations is transformed into a linear equation formally equivalent to the equation for diffusion in a moving medium. The point source solution is extended to the analysis of infiltration from spherical cavities. Although the rate of infiltration from cavities with small or dimensionless radius is determined mainly by capillarity, gravity distorts the moisture distribution pattern strongly, whatever the cavity radius. (Knapp-USGS)
W69-01614

A SOLUTION FOR VERTICAL INFILTRATION INTO A DRY POROUS MEDIUM,
Cornell Univ., Ithaca, New York.
Wilfried Brutsaert.
Water Resources Res, Vol 4, No 5, pp 1031-1038, Oct 1968. 8 p, 4 fig, 1 tab, 9 ref.

Descriptors: *Infiltration, *Unsaturated flow, *Porous media, *Mathematical studies, Soil moisture, Hydraulic conductivity, Diffusivity, Diffusion, Capillary conductivity, Darcys law.
Identifiers: *Vertical infiltration.

An exact solution is presented for the second term of the series expansion of the numerical solution of the concentration-dependent diffusivity equation of J R Philip. The use of simple algebraic functions describing the water content-capillary suction and water content-capillary conductivity relationships of porous media makes the exact solution possible. Terms higher than second order are negligible because of fast convergence. Use of a previous solution for the first term of the expansion together with this solution for the second term is a satisfactory method of calculating vertical infiltration. The method was found to be in good agreement with results of infiltration experiments on Columbia silt loam. (Knapp-USGS)
W69-01615

INFLUENCE OF THE PHYSICAL AND CHEMICAL PROPERTIES OF SOIL ON MEASUREMENTS OF WATER CONTENT USING NEUTRON PROBES,
Vincenzo Cotecchia, Angelo Inzaghi, and Enzo Pirastru.
Water Resources Res, Vol 4, No 5, pp 1023-1028, Oct 1968. 6 p, 2 fig, 2 tab, 12 ref.

Descriptors: *Soil moisture meters, *Nuclear moisture meters, *Calibrations, *Neutron absorption, *Porous media, Measurement, Soil water, Pervious soils, Soil groups.
Identifiers: Neutron flux soil moisture meters, Neutron capture cross sections, Multigroup transport theory.

The influence of soil physical and chemical properties on neutron probe soil water measurement was studied by using multigroup transport theory to calculate thermal neutron flux at various water contents in each soil studied. The media considered are siliceous sand, limestone, dolomitic limestone, and terra rossa. Although elements with high capture cross sections were not present, the media behaved differently in neutron moderation, diffusion, and capture, so that probe response was variable at equal water content in rocks of the same dry density. Interpretation of the results without knowing the effect of the media is not reliable. Agricultural soils, however, show no such differences in neutron behavior. (Knapp-USGS)
W69-01616

THE STEADY-STATE MEASUREMENT OF THE RELATION BETWEEN HYDRAULIC CONDUCTIVITY AND MOISTURE CONTENT IN SOILS,
Sydney Univ., N. S. W., Australia.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01625

2H. Lakes

GEOLOGICAL STUDIES OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor, Great Lakes Research Div., Inst. of Science and Tech.
Jack L. Hough.
Part of final report of USPHS Grant WP-00311. Spec Rep No 30 of Great Lakes Res Div, pp 228-246, 1967. 19 p, 12 fig, 1 tab, 2 ref. ONR-104-818.

Descriptors: *Lake Michigan, *Topography, *Geologic investigations, *Lake beds, Cores, Dredging, Maps, Sediments, Seismic studies, Radioactive dating, Lake stages.
Identifiers: *Bedrock framework, Sub-bottom profiles, Topographic maps.

The topography and geology of the bottom of Lake Michigan were studied by sounding, seismic profiling, and dredging samples. A topographic atlas consisting of four section maps, scale 1:120,000 are published, and quadrangles of scale 1:31,680 were constructed for this study. A 3-dimensional model of the lake basin is under construction. Core samples were taken to investigate sediments in the upper few ft of the bottom with particular emphasis on learning about late glacial to recent depositional changes, particularly changes resulting from human activity. Study of the cores shows that the lakes was relatively barren until a slight degree of eutrophication began just before civilized man reached the area, and eutrophication has continued until the present. Almost no evidence of civilization can be seen in core samples. Core logs also show a low water stage between 10,000 and 4,200 years ago, when the water surface was 350 ft below present lake level. Radiocarbon dating of bottom materials is in progress. (Knapp-USGS)
W69-01619

WATER QUALITY AND EUTROPHICATION TRENDS IN SOUTHERN LAKE MICHIGAN,
Michigan Univ., Ann Arbor, Great Lakes Research Div., Inst. of Science and Tech.
Charles F. Powers, and John C. Ayers.
Part of final report of USPHS Grant WP-00311. Michigan Univ Spec No 30 of Great Lakes Res Div, pp 142-178, 1967. 37 p, 6 tab, 10 fig, 14 ref. ONR-104-818.

Descriptors: *Data collections, *Chemical analyses, *Lake Michigan, *Eutrophication, Water quality, Silica, Calcium, Magnesium, Sulfates, Chlorides, Phosphorus, Nitrates, Biological properties.
Identifiers: *Macrobenthos, Chicago, Milwaukee, Grand Rapids, Whiting, Michigan City.

Chemical analyses of water from municipal water system intakes in the southern part of Lake Michigan were used to study recent trends in water quality and eutrophication. The intakes of the water systems of Grand Rapids, Chicago, and Milwaukee supplied most of the samples, and Whiting and Michigan City supplied a few of less value. The longest record period is 1926-present, at Chicago. Calcium and Magnesium were chosen as standards of comparison because human activity should have little effect on their concentrations. Regression lines in plots of analyses show no significant changes with time. Sulfate, chloride, and total solids are increasing. Silica is decreasing, possibly because of increasing diatom growth with increasing lake productivity. Phosphorus fluctuates markedly at Chicago but open-water samples show no trend. Generally, shore values of all analyses agree very well with open lake values. Dissolved solids, particularly those put in the lake by human activity, are increasing. Other studies show corresponding biological changes that have occurred within the lake. The changes are probably associated with the environmental alteration evident in the long-term change in concentrations of ions and other solids. (Knapp-USGS)

W69-01623

STUDIES OF MILWAUKEE HARBOR AND EMBAYMENT,
Michigan Univ., Ann Arbor, Great Lakes Res Div, Inst of Science and Tech.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-01649

THE INTERNAL DISTRIBUTION OF ANALYSIS VALUES AS AN INDICATOR OF EUTROPHICATION,
Michigan Univ., Ann Arbor, Great Lakes Res Div, Inst of Science and Tech.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-01650

THE GRAND RIVER AND ITS PLUME IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor, Great Lakes Res Div, Inst of Science and Tech.
John C. Ayers, and Ronald Rossman.
Michigan Univ Spec Rep No 30 of the Great Lakes Res Div, pp 366-371, 1967. 6 p, 3 fig, 2 tab, 2 ref.

Descriptors: *Dispersion, *River flow, *Lake Michigan, Turbidity, Temperature, Conductivity, Color, Dissolved oxygen, Water pollution effects.
Identifiers: *Dispersal plume, Grand River (Michigan).

The discharge and mixing of the Grand River, Michigan, into Lake Michigan were studied by sampling the river at 3 stations and taking 7 turbidity samples from the plume of river water in the lake. The river water quality is influenced by several cities and was brown and stained with what appeared to be humic material. Its turbidity ranged from 34.0 ppm to 84.5 ppm. Dissolved oxygen was 8.1 mg/l and 97% saturated. River water conductivity was 550 micromhos/cc at the end of the breakwaters and lake water conductivity was 277. River water temperature was 23.0 deg C while lake water temperature was 18-19 deg. The dispersion plume was mapped by calculating percentage river water at 7 stations on the basis of turbidity, temperature, and conductivity. The studies indicate that dispersal plume study may provide good information on the behavior of nearshore lake waters. (Knapp-USGS)
W69-01651

THE SURFICIAL BOTTOM SEDIMENTS OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor, Great Lakes Res Div, Inst of Science and Tech.
John C. Ayers.
Michigan Univ Spec Rep No 30 of the Great Lakes Res Div, pp 247-253, 1967. 7 p, 4 fig.

Descriptors: *Bottom sediments, *Lake Michigan, *Lake beds, Sediments, Clays, Sampling, Maps, Benthic fauna, Lake soils.
Identifiers: Eutrophication-caused sediment change.

Descriptions of 875 sediment samples taken from the bottom of Lake Michigan are compiled on maps scaled about 10 mi per in. The samples were taken about every 1-5 mi along lines perpendicular to shore, about 5-15 mi apart. The sediments were classified by visual inspection, odor, feeling the fresh samples, and examination with a binocular microscope. (Knapp-USGS)
W69-01652

TEMPERATURE STRUCTURE OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor, Great Lakes Res Div, Inst of Science and Tech.
Vincent E. Noble.
Michigan Univ Spec Rep No 30 of the Great Lakes Res Div, pp 340-365, 1967. 25 p, 1 fig, 4 tab, 3 ref.

Descriptors: *Lake Michigan, *Water temperature, Thermocline, Thermal stratification, Computer programs, Digital computers.
Identifiers: *Temperature structure.

Bathythermograph data for Lake Michigan were put on computer cards and processed by computer. The thermal structure of the lake is presented in tables giving temperature-depth relationships for each month of 1963-1966 at each station listed by latitude and longitude. The computer program used is described, discussed, listed. Conspicuous features in the results are that the summer period when the thermocline exists lasts from the middle of June to the middle of November, and the deep water is warmest at the fall mixing at the end of November or really December. (Knapp-USGS)
W69-01653

JOHNSON V SEIFERT (RIPARIAN OWNER'S RIGHT TO USE OF ENTIRE LAKE SURFACE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01929

ANNUAL GROWTH CYCLE, GROWTH POTENTIAL, AND GROWTH COMPENSATION IN THE BLUEGILL SUNFISH IN NORTHERN INDIANA LAKES,
Indiana Univ., Bloomington. Dept. of Zoology.
Shelby D. Gerking.
J Fish Res Board Canada, Vol 23, No 12, pp 1923-1956, 1966. 34 p, 7 fig, 6 tab, 54 ref.

Descriptors: *Secondary productivity, *Sunfishes, *Growth rates, Indiana, Lakes, Productivity, Fish, Period of growth, Indicator organisms, Thermoperiodism, Photoperiodism, Feeding rates.
Identifiers: *Bluegills, *Lepomis, Sylvan Lake, Carr Lake, Maxinkuckee Lake, Spear Lake, Crooked Lake, Ridinger Lake, Pretty Lake, Growth hormone, Glacial lakes, High Lake.

Eight lacustrine populations of bluegill sunfish with widely varying growth rates exhibited a surge of growth in spring followed by a progressive decline in late summer and autumn. Growth rate declined as age increased; in no case did growth of an older age group exceed that of a younger age group in the same year. Length of growing season (period between annulus formation and achievement of 90% annual growth) varied among lakes and between years in same lake (mean: 152 days; range: 98 (Ridinger L)--189 (Maxinkuckee L)). In Ridinger L, season extended a month longer in 1963 than in 1962, but this difference was not evident in other lakes. When ranked according to growth rate of resident fish, each lake retained same position in both 1962 and 1963. Populations experiencing longer growth seasons grew more rapidly than those with shorter seasons. Author presents evidence that all populations demonstrated approximately equal growth potential as judged by weight increment of fish of group III. Growth compensation may result from earlier inception of growth in smaller fish. Author reviews possible explanations of annual growth cycles as related to temperature, photoperiod, and interactions between growth hormone and seasonal feeding rates. (Wis)
W69-01976

DUVAL V THOMAS (RIGHT TO REASONABLE USE OF LAKE SURFACE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01992

LEATHERSICH V NEW YORK STATE WATER RESOURCES COMM'N (ADMINISTRATIVE DECISIONS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01998

2I. Water in Plants

ALBEDO OF INTERCEPTED SNOW,
Northeastern Forest Experiment Station and Syracuse Univ., College of Forestry, Syracuse, New York.
Raymond E. Leonard, and Arthur R. Eschner.
Water Resources Res, Vol 4, No 5, pp 931-935, Oct 1968. 5 p, 4 fig, 2 ref.

Descriptors: *Interception, *Snow, *Albedo, *Evaporation, Energy budget, Radiation, Water loss, Conifers, Red pine trees.
Identifiers: Intercepted snow loss, Solar altitude.

Incident and reflected shortwave radiation above a red pine plantation was measured at 30-minute intervals for 2 days after a 12-in. snowfall to determine whether enough energy is absorbed to evaporate a significant amount of the intercepted snow. Maximum albedo was less than 20% of incident radiation, compared with the 70-90% for fresh snow on the ground and commonly assumed to apply also to intercepted snow. Energy available for evaporation of intercepted snow may be 4 times the amount previously assumed. As intercepted snow aged, albedo decreased and eventually approached summer values when snow left the upper part of the canopy. With an albedo of 0.20 a net solar radiation of 36 langleys per hour caused evaporation of 0.6 mm water per hour, or 2.00 mm per day, showing that a considerable amount of intercepted snow may be lost to evaporation. (Knapp-USGS)
W69-01598

CONVERSION OF HARDWOOD-COVERED WATERSHEDS TO WHITE PINE REDUCES WATER YIELD,
Southeastern Forest Experiment Station, Asheville, N. C.
W. T. Swank, and N. H. Miner.
Water Resources Res, Vol 4, No 5, pp 947-954, Oct 1968. 8 p, 6 fig, 1 tab, 17 ref.

Descriptors: *Water yield, *Forests, *Reforestation, *Interception, *Watershed management, Coniferous forests, Deciduous forests, White pine trees, Canopy, Demonstration watersheds.
Identifiers: Southern Appalachians.

Mixed mature hardwoods were cleared from two Southern Appalachian experimental watersheds and the cleared areas were planted with eastern white pine to determine the effect of forest composition on runoff. When the pine crowns began to close, streamflow steadily declined at a rate of 1 to 2 in. per year. By 1967, water yield was 3.7 in. less from a 10-year-old pine stand on a southfacing watershed than expected water yield from the original hardwood forest. Most of the water yield reduction occurred during the dormant season and was attributed mainly to greater interception loss from white pine than from hardwoods. Because interception differences increase as white pine matures, an even greater reduction in streamflow is expected. (Author)
W69-01624

2J. Erosion and Sedimentation

FLOOD SURGE ON THE RUBICON RIVER, CALIFORNIA--HYDROLOGY, HYDRAULICS AND BOULDER TRANSPORT,
U S Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01610

RELATION OF SEDIMENT LOAD TO HYDROLOGICAL CHARACTERISTICS OF

CONNECTICUT RIVER BETWEEN NORTHFIELD AND SPRINGFIELD, MASSACHUSETTS,
Massachusetts Univ., Amherst, Dep of Geology.
Miles O. Hayes.
Mass Univ, Water Resources Res Center Symp Proc, Publication No 3, pp 53-61, June 2, 1967, 9 p, 1 fig, 3 tab, 2 ref.

Descriptors: *Sediment load, *Connecticut, River basins, Bed load, Suspended load, Depth, Velocity, Dams, Massachusetts, Laboratory tests, Particle size.
Identifiers: Connecticut River, Geologic controls.

The sediment load of the Connecticut River, the largest river in New England, is being studied. Geographic and geologic settings are described. A longitudinal profile of the river from Turners Falls Dam to Holyoke Dam was drawn. Velocity measurements and mean diameter of the bed load are plotted. North of Amherst, Mass, the predominant bed load is gravel, and south of Amherst it is sand. Partial analyses of sediment sizes from the main channel and tributaries are tabulated. (Knapp-USGS)
W69-01637

FALL VELOCITY OF IRREGULAR SHAPED PARTICLES,
Michigan Technolog Univ., Houghton, and Colo. State Univ., Ft. Collins.
George R. Alger, and Daryl B. Simons.
ASCE Proc, Jour Hydraul, Vol 94, No HY3, Paper 5949, pp 721-737, May 1968. 17 p, 11 fig, 4 tab, 6 ref, 2 append.

Descriptors: *Particle shape, *Settling velocity, *Hydraulics, Fluid mechanics, Particle size, Flow separation, Vortices, Sediments, Reynolds number, Resistance.
Identifiers: *Shape factor, *Fluid flow, Drag, Vortex formation, Particle motion, Fluid viscosity.

The importance of surface area and volume of particles in sediment fall velocity is determined and a particle shape factor is developed that includes these variables. Free-fall velocity of variously shaped particles in fluids of different viscosity is determined. A shape parameter is proposed which correlates Reynolds number with drag coefficient to describe the motion of irregular shapes. This results in a useful Reynolds number-drag coefficient relation. Data for analysis were collected from tests of natural gravel-sized particles of various shapes and sizes supplemented by larger geometric shapes. The basic motions--sliding, tipping, and rotation--of particles in free fall may occur separately or be combined depending on such causes as flow separation and vortex formation. (Lang-USGS)
W69-01640

THE SURFICIAL BOTTOM SEDIMENTS OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor, Great Lakes Res Div, Inst of Science and Tech.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-01652

RAND V MILLER (ACTION TO QUIET TITLE TO ACCRETION LANDS SEPARATED FROM RIPARIAN LANDS BY AVULSION).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01951

ROLE OF SILT IN WATER POLLUTION,
R. D. Walker.
Amer Water Works Ass J, Vol 58, No 11, pp 1483-1488, Nov 1966. 6 p, 2 tab, 1 fig, 6 ref.

Descriptors: *Illinois, *Silts, Water pollution sources, Agricultural watersheds, Surface runoff, Erosion, *Erosion control, *Gully erosion, Sheet erosion, Desilting, Sedimentation, Conservation, Dams.

Silt is defined as any soil material carried by moving water or deposited as sediment. The amount of silt reaching a reservoir or treatment plant can be reduced by soil conservation practices within the watershed. The two major kinds of soil erosion are gully erosion and sheet erosion. Gully erosion occurs where water flow is concentrated while sheet erosion carries away a thin layer of soil with each rain. Soil erosion occurs in two phases: (1) the impact of the rain breaking loose soil particles and (2) surface runoff carrying away the particles. Erosion may be held to a minimum by reducing the impact, usually with a vegetative cover, and minimizing runoff speed. On agricultural land this may be accomplished by proper crop rotation and contour farming. A universal equation has been developed by the Soil Conservation Service to figure soil losses in a given watershed before a conservation project and to compare them with probable losses afterwards. Urban construction also causes much soil loss. Dams constructed on the Missouri River have proved effective in reducing silt, as have other projects under the Watershed Protection and Flood Prevention Act and in the conservation districts which exist in all Illinois Counties. (Kahle-Fla)
W69-01968

2K. Chemical Processes

WATER QUALITY AND EUTROPHICATION TRENDS IN SOUTHERN LAKE MICHIGAN,
Michigan Univ., Ann Arbor, Great Lakes Research Div., Inst. of Science and Tech.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-01623

GROUNDWATER CONTAMINATION AND HYDROCHEMICAL FACIES OF SHALLOW AQUIFERS IN MASSACHUSETTS,
Massachusetts Univ., Amherst, Dep of Geology.
Ward S. Motts.
Mass Univ, Water Resources Res Center Symp Proc, Publication No 3, pp 29-38, June 2, 1967. 10 p, 1 fig, 5 tab, 5 ref.

Descriptors: *Groundwater, *Water quality, *Geochemistry, Aquifers, Salinity, Iron, Chlorides, Massachusetts, Geohydrologic units.
Identifiers: Hydrochemical facies, Groundwater contamination.

The chemical quality of water in shallow aquifers in Massachusetts was studied to learn the variation of quality caused by geology, geormorphic location, and contamination. About 40% of the wells studied are on floodplains, 16% above floodplains, 11% in swamps, 15% near lakes, and 18% on flats. The highest concentrations of Fe and Mn are near groundwater discharge areas and the lowest are in recharge areas. Most groundwater in the state is in the acidic facies, associated with non-calcareous rocks. The alkaline facies of western Massachusetts is associated with limestone; in the Connecticut valley the alkaline facies contains more sulfate and is associated with Triassic basalts and redbeds. In eastern Massachusetts an alkaline facies is associated with the Salem Gabbrodiorite. Mineralization is increasing slightly in the wells sampled. Over 50% of the wells sampled showed increases in Cl from 1955-66. 50% of those near discharge areas doubled in Cl, but none contain over 150 ppm Cl. The increase is caused by salt used for highway snow removal, drainage from dumps, septic tank pollution, and other causes. (Knapp-USGS)
W69-01639

2L. Estuaries

TURBIDITY MAXIMUM OF THE NORTHERN CHESAPEAKE BAY,
Johns Hopkins Univ., Baltimore, Maryland, Chesapeake Bay Inst.
J. R. Schubel.
Science, Vol. 161, pp 1013-1015, Sept 6, 1968. 3 p, 2 fig, 10 ref.

Descriptors: *Estuarine environment, *Turbidity, *Suspended load, Streamflow, Rivers, Bay, Sediment distribution, Flocculation, Particle size, Circulation.
Identifiers: *Turbidity maxium, *Chesapeake Bay, Tidal cycles.

The turbid zone from head Chesapeake Bay at Turdey Point seaward for 32 km was comprehensively studied in 1966-67 and results are summarized. Samples collected fortnightly from several depths at each of 15 stations were analyzed for concentration of total suspended solids, combustible organic matter, the mineralogy, and size distribution of suspended particles. Other samples were collected at stations farther seaward in the estuary, and at several anchor stations where hourly measurements of current velocity, suspended sediment concentration, temperature, and salinity were made over 2 or more tidal cycles. Extensive size analyses of river and bay samples by a photomicrographic method and by a sediment technique failed to show any evidence of either flocculation or deflocculation of river-borne sediment. The turbidity maximum near the head of Chesapeake Bay is produced mainly by local resuspension of bottom sediments, and by the estuarine 'sediment trap' formed in the upper part of the estuarine circulation regime by the net nontidal circulation. (Land-USGS)
W69-01600

INTERNAL IMPROVEMENT TRUST FUND.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01933

INTERNAL IMPROVEMENT TRUST FUND.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01934

INTERNAL IMPROVEMENT TRUST FUND.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01935

MATZOK V GLEN COVE YACHT SERVICE REPAIR, INC. (EASEMENT OF ACCESS TO NAVIGABLE PORTION OF STREAM).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01943

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

GEOLOGIC FACTORS IN COMMUNITY DEVELOPMENT AT NAPERVILLE, ILLINOIS,
Illinois State Geological Survey, Urbana.
J. E. Hackett.
Environ Geol Notes No 22, 16 p, June 1966. 4 fig, 11 ref.

Descriptors: *Planning, *Illinois, *Water resources development, City planning, Long-term planning, Flood plain zoning, Local governments, Urbaniza-

tion, Water quality, Municipal water, Groundwater, Surface waters, Aquifers, Reservoirs.
Identifiers: *Physical environment, Dupage County (Illinois), Area development, Chicago suburbs, Geologic factors.

A planning study conducted by a citizens' committee of the Naperville Community Council reviewed the role of the physical environment in the development of an expanding community. Data on geology, groundwater resources, streamflow and extent of flooding are compiled. The city grew from 12,933 in 1960 to 18,734 in 1966; this has resulted in expansion of water, sewage disposal, and storm water drainage control facilities. The city is on the West Branch Dupage River which has an average flow of 50 cu ft per sec and carries waste from upstream sources. There is little possibility that surface water reservoirs of sufficient size will be developed because valleys are shallow, relief in the area is generally low, and streamflow is low. Groundwater supplies are available from sand and gravel deposits, the dolomite bedrock, and from deep sandstones. Present municipal wells include 4 in the dolomite and 1 in the deep sandstones. Total pumpage is 1.5 mgd, or about 75 gal per capita. The hardness is 400 to 500 ppm, but the water is free of bacterial pollutants. (Knapp-USGS)
W69-01594

3C. Use of Water of Impaired Quality

PLANNED CITY PLANS TO RE-USE STORM RUNOFF.

Environ Sci Technol, Vol 1, No 11, p 875, Nov, 1967.

Descriptors: *Water reuse, *Storm runoff, *Water pollution control, Equipment, Sewage treatment.
Identifiers: *Storage tanks, *Urban drainage, *Columbia (Md).

A plan to store storm water locally, thus controlling pollution, and then to amortize construction costs by reusing the water for high-volume needs is being studied in the planned city of Columbia, Maryland. The plan calls for collecting rain runoff in neighborhood reservoirs, or even in mass produced storage basins for individual residences. Methods and equipment for treating the water to make it suitable for non-drinking purposes are also being studied.
W69-01759

USE OF STORM RUNOFF FOR ARTIFICIAL RECHARGE,
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-01864

FUTURE WATER QUALITY DESIGN,
California State Department of Public Health, Berkeley.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-01982

3D. Conservation in Domestic and Municipal Use

WATER PRICING IN RESIDENTIAL AREA,
For primary bibliographic entry see Field 06C.
For abstract, see .
W69-01986

CHALLENGES IN THE WATER INDUSTRY,
Raymond J. Faust.
Journal of the American Water Works, Vol. 55, No. 6, June 1963, pp 661-667, 3 ref.

Descriptors: Water resource management, Municipal water supply, *Water quality control, Water rates, Standards, Revenue, Peak load, Research and development, Adoption of practices, Water quality, Administration, Administrative decision.
Identifiers: *Water utility industry, Water service, Consumer needs, American Water Works Association.

The water industry today faces many challenges. Service is the keystone of the water utility industry and excellent service must always be the goal. Inadequate planning is the main cause for inefficient service, causing deficiencies in one or more of the major facilities of a water system - that is, in source, treatment, pumping, transmission, storage, and distribution. Water quality, as measured by technical standards and consumer needs, is also one of the major areas needing research and improvement. To achieve the goal of quality water for the consumer a new water standard promulgated by the industry, through AWWA, will be needed. Many of the deficiencies of these two areas of service and quality can be ascribed to insufficient revenue. As the only significant source of revenue of a water utility is the sale of water, it becomes obvious that such sales should be based on rates that will yield sufficient money to operate and maintain the system, pay debt service, employ a competent staff and keep the plant up to date to meet peak loads and operating emergencies. The key to superior consumer service is the improvement of all the above mentioned factors, but this can only come from total management. Without qualified management it is impossible to meet the challenges of the industry. (Gargola-Chicago)
W69-01989

3F. Conservation in Agriculture

A STUDY OF EVAPORATION SUPPRESSANTS UNDER GREENHOUSE CONDITIONS: EVALUATION 1 AND 2,
South Plains Research and Experiment Center, Lubbock, Tex.
C. W. Windt, and J. R. Runkles.
Tex A and M Univ, Agr Exp Sta Progr Rep PR 2510 and PR 2542; 10 p, 13 p; Feb 9, 1968; May 15, 1968. 8 fig, 1 tab, 4 ref; 10 fig, 3 tab, 1 ref.

Descriptors: *Evaporation control, *Soil moisture, *Chemcontrol, *Oil, Air-earth interfaces, Water loss.
Identifiers: Crude oil, Polysaccharides, Anions, Cations, Latex.

Crude oil and crude oil plus additives including an anionic, a cationic, a nonionic, an oil-latex mixture an0 a polysaccharide-gum mixture were evaluated as evaporation suppressants on an Olton loam soil under greenhouse conditions. The 150-gallon-per-acre rates of crude oil was superior to a 50-gallon-per-acre rate. Evaporation was further suppressed when a cationic, oil-latex mixture and a polysaccharide-gum mixture were added to the 150-gallon-per-acre rate of crude oil. In some cases, the anionic enhanced suppression when it was added to crude oil but not as much as the cationic, oil-latex mixture or polysaccharide-gum mixture. The nonionic apparently decreased the ability of soil to suppress evaporation. An attempt was made to create a dry barrier on the soil surface using a propane flame. However, the moisture was replenished as fast as it was evaporated so that a dry layer was never created. (Knapp-USGS)
W69-01595

EVAPORATION FROM BOGS, DEPENDING ON CLIMATE, DRAINAGE, AND CULTIVATION (RUSSIAN),
A. I. Ivitskii.
Translation from Gidrotekh i Melior No 1-2, pp 62-66, 1968. TT67-51385 6 p. Issued by CFSTI.

Descriptors: *Wetlands, *Bogs, *Soil physical properties, *Soil chemical properties, Soil water plant relationships, Evaporation control, Runoff, Drainage effects.
Identifiers: *USSR, *Bog drainage, Marsh hydrology.

Results and conclusions of calculations previously made for undrained, drained, and cultivated bogs in the USSR are reviewed. The evaporation values obtained from the 1932-34 experiments on peat soil were carried out in evaporators of cross section 25 X 4 cm and 100 cm height. Also presented are experimental results from the Institute of Bog Management. These experiments were carried out with lysimeters on the Minsk bog station. An 0.8 X 0.8m cross-section lysimeter in which the peat was arranged in layers, was used; evaporation was determined by the volumetric method. It was concluded that evaporation from the peat soil without ground cover at shallow water table is higher, and at deep water table it is lower than the sum total of rainfall during the summer. Moreover, bog evaporation is lower than evaporation from the water surface. A drained but uncultivated bog evaporates about half the water evaporated by an undrained bog, but cultivated grasses in a drained bog reduces evaporation as compared with undrained conditions. Thus, drainage of bogs without subsequent cultivation increases total runoff. (Laverias-USGS)
W69-01627

RELIEVING OVERLOAD ON TAMWORTH SEWAGE WORKS.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01686

DEVELOPMENT OF IRRIGATION DISTRICTS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01965

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on THE Surface

PRINCIPAL HEIGHT ZONES OF STREAMFLOW FORMATION IN CENTRAL ASIA IN DIFFERENT MONTHS OF THE GROWING SEASON,
For primary bibliographic entry see Field 02C.
For abstract, see .
W69-01601

UNIFORM FLOOD-FREQUENCY ESTIMATING METHODS FOR FEDERAL AGENCIES,
U S Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-01609

SMALL WATERSHED STORAGE USING LOW DAMS,
Massachusetts Univ, Amherst, Dep of Civil Engineering.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01636

SEEPAGE THROUGH AN EARTH DAM COMPUTED BY THE RELAXATION TECHNIQUE,
Stanford Univ., Stanford, California.
E. J. Finnemore, and Byrne Perry.
Water Resources Res, Vol 4, No 5, pp 1059-1067, Oct 1968, 9 p, 6 fig, 1 tab, 13 ref.

Descriptors: *Seepage, *Earth dams, *Homogeneity, Levee, Mathematical studies, Darcys law, Methodology, Computer models, Permeability, Steady flow, Phreatic lines.

Identifiers: *Relaxation technique, Free streamline.

An investigation is made of the problem of seepage through a homogeneous earth dam or levee assuming the flow is plane, steady, and governed by Darcy's law. The Laplace equation is used as the governing equation for the pressure head, with straightforward boundary conditions except at the phreatic surface. This surface is a free streamline whose location is initially unknown. Solution of the problem is reached by adopting the relaxation method for machine computation. Solutions obtained for separate executions having widely different initial positions of the streamline agreed closely. The solutions required from 50 to 70 seconds on an IBM 7090, and they agree well with the longhand computations of Shaw and Southwell. The computer flow rates agree closely with the theoretical discharge of the Dupuit formula. Variations in permeability, which are difficult or impossible to deal with by classical methods, can easily be incorporated into the computation scheme. (Lang-USGS)
W69-01641

BUILT TO BE SEEN,
Wilsey and Ham, San Mateo, Calif.
For primary bibliographic entry see Field 08C.
For abstract, see .
W69-01675

THEORETICAL CONSIDERATION OF SIDE WEIRS AS STORM WATER OVERFLOWS,
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01677

HYDRAULIC DESIGN OF STORM SEWAGE OVERFLOWS INCORPORATING STORAGE,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01678

LABORATORY STUDIES OF STORM OVERFLOWS WITH UNSTEADY FLOW,
P. Ackers, A. J. M. Harrison, and A. J. Brewer.
Symp on Storm Sewage Overflows, May 1967.

Descriptors: *Storm runoff, *Overflow, *Weirs, *Stilling basins, *Model studies, Instrumentation, Water pollution, *Chemical analysis.
Identifiers: *Suspended solids.

Models of four types of typical overflows: (1) a low side weir, (2) a stilling pond, (3) a vortex with central spill, and (4) a storage overflow with high side weir, were tested at two pipe slopes, 1:500 and 1:100. The model overflows were installed in turn at the downstream end of the pipe. The salinities of the base flow, the spilled water and water passed to treatment were measured by electrical conductivity meters. Suspended and floating materials were introduced into the pipe by screw-feed injector, heavier material being put in by hand upstream. Solids were collected by sieves. The tests were divided into two categories: (a) those investigating the discharge of dissolved pollution and (b) those studying the behavior of bed load and suspended and floating solids. Each structure was first tested with saline-base flow and fresh-water storm waves of 1, 2, 3, and 4 mins. duration. Recorder charts were analyzed for each structure and the duration of each test in turn, to obtain the discharge time curves shown. The proportions of pollutants spilled to the wave duration are shown by graphs as well as the average concentrations of pollutants in the spill as proportions of a base flow concentration each for salt, polystyrene, bakelite, polythene, and polythene with scum boards.
W69-01679

PRELIMINARY GUIDANCE FOR THE CALCULATION AND DESIGN OF STORM-SEWAGE OVERFLOWS IN COMBINED SEWAGE SYSTEMS.

Abwassertechnische Vereinigung, 1962. 26 p.

Descriptors: *Overflow, Rainfall-runoff relationships, *Design.
Identifiers: Storm sewers, *Combined sewers.

Based on existing information on rainfall and runoff in sewerage systems, preliminary measures are suggested for the calculation and design of storm-sewage overflows by determining the critical intensity of rainfall at which an overflow first occurs, which is illustrated by nomograms. This method of calculation is not as straightforward as the existing dilution process but it has the advantage that predictions can be made on both the frequency of operation and the duration of the overflow. It is these criteria which determine the state of pollution in the receiving water and permit a uniform and even treatment of the storm-sewage overflow in a cross section of the channel. This confirms the usefulness of this method, since heavy rainfall in sewerage systems can be retained, thus reducing the polluting load on the receiving water.
W69-01682

KENT SEWERAGE WORKS FOR 9000 PEOPLE.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01683

CHICAGO STUDIES PLAN FOR CONTROLLING COMBINED SEWER OVERFLOWS.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01689

METHOD OF AND MEANS FOR DEALING WITH STORM-WATER OVERFLOWS IN SEWERS AND LIKE DRAINAGE SYSTEMS.
Longwood Engineering Co., Ltd.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01690

TECHNICAL COMMITTEE ON STORM OVERFLOWS AND THE DISPOSAL OF STORM SEWAGE.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01691

STORM WATER OVERFLOWS. THE USE OF SIPHONS AT IPSWICH,
R. N. Barrett.
J Instn Munic Engrs, Vol 85, pp 33-42, 1958.

Descriptors: *Overflow, *Siphons, Weirs, *Storm runoff.
Identifiers: *Combined sewers.

The author describes experiences at Ipswich in the design and operation of siphon overflows for removal of excess storm water from combined sewerage systems. Siphon overflows are considered to have certain advantages over the more commonly used side-weir overflows.
W69-01692

DESIGN OF UNDERWATER STORM WATER OVERFLOW STORAGE SYSTEM,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01693

DRAW-DOWN AND OTHER FACTORS RELATING TO DESIGN OF STORM-WATER OVERFLOWS ON SEWERS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01695

AN INVESTIGATION OF HEAD LOSSES AT SEWER MANHOLES,
P. Ackers.
Civ Eng, London, Vol 54, 1959.

Descriptors: *Manholes, *Head loss, Overflow, Sewers.

The author describes the results of experiments on factors affecting head losses at sewer manholes. It was found that head losses at open invert manholes are small except when surcharge occurs and hatch-box manholes are no better except under surcharge conditions.
W69-01697

THE HYDRAULIC RESISTANCE OF DRAINAGE CONDUITS,
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01698

TABLES FOR THE HYDRAULIC DESIGN OF STORM-DRAINS, SEWERS, AND PIPE-LINES,
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01699

POLYMER COAGULATORS.
Environ Sci Technol, Vol 1, No 2, p 111, Feb 1967.

Descriptors: *Flow control, Storm runoff.
Identifiers: *Polymers, *Combined sewers, *Capacity.

The research division of the Western Co. is studying the feasibility of adding polymer coagulators to combined sewer-storm lines to enable them to carry greater quantities of sewage during rains. The additives increase fluid flow in pipes by reducing turbulent friction loss. If the method proves feasible, demonstration tests will be conducted in the Dallas-Fort Worth area in mid-1968.
W69-01701

HYDRAULIC DESIGN OF DEPRESSED CURB-OPENING INLETS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01702

STORM WATER TANKS WITHOUT GRADIENTS, A METHOD OF IMPROVING THE SEWERAGE SYSTEMS OF TOWNS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01708

OPTIMUM DESIGN OF SEWERS,
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01710

DEEP TUNNEL SYSTEM GETS OFF THE GROUND.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01712

ASCE SEWER PROJECT CONTINUES.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01713

COMPUTERS TO CONTROL COMBINED SEWERS.

Environ Sci Technol, Vol 1, No 10, p 777, Oct, 1967.

Descriptors: *Computer program, *Overflows, Storm runoff, *Automatic control, Sampling.
Identifiers: *Combined sewers, Urban drainage.

The Minneapolis-Saint Paul Sanitary District is working on a $1.7 million demonstration project to use a process control computer to control combined sewer overflows. When heavy rainfall causes the sewers to overflow, the excess is diverted into the river through gates in the sewers. The computer will be used to see that the most polluted flow goes to the treatment plant and the cleaner water to the river. The system will rely on data telemetered from 28 sampling stations to the computer at the plant. The data will include the amount of rainfall, sewer levels, and gate positions. Using simulation techniques, sewage plant operators can determine the best settings on control gates to get maximum pollution to the plant and minimum pollution to the river.
W69-01716

DRAINAGE (SEWERAGE).
For primary bibliographic entry sec Field 08B.
For abstract, see .
W69-01718

DRAINAGE (SEWERAGE).
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01722

STORM-WATER OVERFLOWS FROM COMBINED SEWERS,
H. H. Benjes, P. D. Haney, and O. J. Schmidt.
J Water Poll Control Fed, Vol 33, p 12, 1961.

Descriptors: *Storm runoff, *Overflow, *Rainfall-runoff relationships.
Identifiers: *Combined sewers, Kansas City (Mo.), *Interceptor sewers.

Advocate using peak dry-weather flow rather than average dwf in determining a ratio for interceptor sewers. This helps decrease the per cent difference in peak to average DWF found because of size of community. Agreement with other investigators that from 0.03 to 0.04 in./hr is needed to wet down area before run-off. Each 0.01 in./hr will produce run-off equal to DWF. In Kansas City it was found that measurable rainfall occurred about 5 per cent of the time. Of this 3.7 per cent of the time run-off could occur. With a peak dwf of 1.5 x ave. dwf and a interceptor capacity of 1.5 x ave DWF it was found overflow would occur 3.72 percent time = to peak dwf. If interceptor was increased to 3.5 ave dwf, overflow would still occur 3.22 per cent of time and 6.5 x ave dwf 2.3 per cent of time. Authors conclude that the practical maximum effective capacity of interceptor can not be much larger than the peak dwf. Also recommend more work be done in characteristics of storm water runoff.
W69-01726

PRINCIPLES FOR CALCULATING FLOWS IN SEPARATE AND COMBINED SEWERS,
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01727

INFILTRATION INTO SEWERS.
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01732

EXFILTRATION TESTING OF LARGE SEWERS.
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01733

HANDLING SANITARY SEWAGE AND STORM WATER, ROUND TABLE DISCUSSION.

Wastes Eng, Vol 31, No 4, p 215, April 1960.

Descriptors: *Storm runoff, Sewers, Settling basins, *Equipment, *Maintenance.
Identifiers: *Combined sewers.

Primarily interested in effect of storm water on flushing out of sanitary lines with resulting loss of effectiveness of grit chambers and overloading of settling tanks. Essentially an operational forum on equipment usage and effects on maintenance.
W69-01734

ESTIMATING THE CAPACITY OF SEWERS AND STORM DRAINS,
P. Ackers.
Munic Eng, London, Vol 142, p 170, 175, 1965.

Descriptors: *Sewers, *Storm drains, Pipes, Flow measurement, Slime.
Identifiers: *Capacity.

Recent investigations on sewer capacities, conducted at the Ministry of Technology, Hydraulics Research Station, are summarized. Experiments using clean, salt-glazed, precast concrete, and pitch-fibre pipes confirmed the validity of the Colebrook-White friction formula (but not the Crimp and Bruges or Manning equations), and also showed that pitch-fibre pipes, when clean, have an hydraulic capacity 5-10 per cent greater than the others. The effect of imperfect joints in salt-glazed pipes on the roughness coefficient was found to be directly related to the degree of eccentricity and the spacing of the joints. To investigate the effect of slime layers, flow-velocity measurements were made in 20 sewers of various ages, materials, sizes and gradients, and the roughness coefficients were calculated. The results, which are tabulated, indicate that slime layers form quite rapidly in sewers, and that the roughness factor increases with increasing thickness of the layer, giving a corresponding reduction in capacity.
W69-01751

PROVIDE DRAINAGE BEFORE FLOODS OCCUR.

Amer City, Vol 75, p 2, 1960.

Descriptors: *Storm runoff, *Water pollution, *Storm drainage, Pumping, Sewage treatment, Sewers.
Identifiers: *Storm sewers, *Urban drainage.

Present sewerage facilities serving the Counties of Macomb and Wayne, Michigan are grossly inadequate. The area is drained by Milk river which is very slow flowing and sometimes stagnant, and a rapid increase in population resulting in an increase in the volume of storm water has augmented the problem. A project to improve the sewerage facilities, started in September 1958, includes the construction of two pumping stations, a main pumping station with skimming and sedimentation tanks located about 3/4 mile upstream from the mouth of the Milk river and a low-lift pumping station about 1/2 mile downstream from the main pumping station. Radial gates have been installed in the river so that the water between the two stations can be changed when necessary. The new Milk river sewer, although designed primarily for storm water use, will carry a small quantity of sewage during storm periods. Under normal dry weather conditions all sewage is discharged to the Wayne County interceptor system and then to the Detroit sewage-treatment plant.
W69-01753

FLOOD RELIEF PROJECT IN LONDON SUBURB.

Civ Eng and Public Wks Rev, Vol 63, No 744, p 761, July 1968.

Descriptors: *Surface drainage, *Tunnels, *Construction, Manholes, *Velocity, Outlet, *Flood control.
Identifiers: *Sewer flushing, *London (Great Britain), *Storm sewers.

In an effort to relieve flooding in the London Borough of Redbridge a new system of surface sewers was constructed in a tunnel about 30 ft below ground level. Access shafts were constructed of 11 ft. internal dia. reinforced concrete bolted segments. On completion of tunnelling operations they were converted into drop-manholes to transfer the excess flow from the existing system down into the new tunnel system. In addition to the connections to the existing system it was necessary to include a number of drop-manholes in the scheme since it was felt that the gradients of the new sewers should be designed so that the velocity of flow would be kept below 12 ft. per second to prevent excessive abrasion of the tunnel by grit, etc. It was found that the amount of noise produced by the flow in the drop-manholes has been low and no complaints have been received even though the manholes are sited in the road outside residential property. The flow passes down a vertical cast iron pipe into a water cushion at the bottom of the shaft. The water cushions have proved successful since although there is a build up of grit and debris at low flows, at peak flows the debris is disturbed and flushed down the pipe to the outfall. The water cushions are designed in such a way that they will not choke up with debris during prolonged low flow conditions.
W69-01754

NEW SEWERAGE FOR CROYDON.

Civ Eng and Public Wks Rev, Vol 63, No 743, p 666, June 1968.

Descriptors: Sewers, *Tunnels, *Construction.
Identifiers: *Storm sewers, *Capacity.

The Borough of Croydon on the border of Surrey has been carrying out a program of new building including commercial development, which has raised a demand for additional sewage capacity. Accordingly, foul water and storm water sewerage has been laid down. The tunnel for the new sewer was sunk at a depth of 40 ft. below street level and was constructed of precast concrete segments. Tunnel diameters varied between 6 ft. and 7 ft. in the former, the foul water channel was of 24 in. dia. and of 27 in. dia. in the remainder.
W69-01755

STORM SEWER DESIGN AND ANALYSIS BY COMPUTER.

Consulting Engr (London), Vol 30, No 7, pp 78-81, July 1966.

Descriptors: *Design, Overflow, Outlets, Computer programs.
Identifiers: *Storm sewers.

Three ways in which computer program can solve problems related to storm sewer design and analysis; in analyzing existing system for each pipe, output contains indication of overloading, together with measure of surcharge; by redesigning existing system, program analyzes existing system and, if any pipe is surcharged, it indicates surcharge and calculates correct size for that pipe by adding small increments to cross sectional area; new system design in which each pipe is considered separately outfall of pipe under consideration being taken as outfall of network upstream of this point.
W69-01757

HIGHWAY BRIDGE MEN BUILD TUNNEL FOR WATER.

Eng News Rec, Vol 174, No 15, pp 34-6, Apr 15 1965.

Descriptors: Drilling equipment, *Tunnel construction, Storm drains, Outlets.
Identifiers: Storm sewers, Urban drainage.

Construction of 4.29 mi. bored trunk storm drain for Interstate Route 280 in New Jersey that is depressed through Newark, East Orange and Orange; drain will carry water from these areas to outfall in Passaic River; sewer has circular cross section 8-ft. in diam, its wall is 1-ft-thick cast-in-place concrete; for 3.86 mi., its depth below existing ground level ranges from 35 to 73 ft. and averages about 60 ft.
W69-01758

UTILIZATION OF STREAM FOR STREAM DAMAGE.

Public Works, April 1967.

Descriptors: *Drainage systems, *Storm drains, Sewers, Storm runoff.
Identifiers: *Urban drainage.

A municipality is legally liable for defects and obstructions in sewers and drains whether a natural watercourse is adopted for drainage purposes or an artificial channel is built. A legal case illustrating this point is discussed wherein the city was proved liable for water damage when a rainstorm backed up waters in a stream used as part of the city's storm drainage system.
W69-01760

STANDARDS FOR STORM-WATER FACILITIES.

Pub Works, Vol 91, No 2, p 91, 1960.

Descriptors: *Standards, *Storm runoff, Design, Maintenance.
Identifiers: *Storm sewers, *St. Louis (Mo.), *Urban drainage.

The new standards for storm-water channels, established by the St. Louis Metropolitan Sewer District in order to reduce erosion and reduce maintenance costs and to provide definite data for storm sewer and ditch design, are outlined with the aid of diagrams.
W69-01761

FLOOD RELIEF SCHEME FOR WEST LONDON.

Survr, Vol 122, No 3728, p 1429, Nov 16, 1963.

Descriptors: Pumping, Storm runoff.
Identifiers: *Storm sewers, London (England).

Extensions to existing flood relief system in West London include Hammersmith storm relief sewer and pumping station; new station will contain 8 electrically driven 42-in.-diam pumps with total capacity of 1500 tons/min; just before pumping station, 6-ft and 2 8-ft sewers will combine into approach channel 24 ft wide and 120 ft long which will house penstocks and screens to protect pumps.
W69-01763

SURFACE WATER AND SUBSOIL DRAINAGE.
British Standards Institution, London, 1952.

Council for Codes of Practice for Buildings, British Standard Code of Practice CP 303, 1952.

Descriptors: *Storm drains, *Design, *Surface drainage, *Rainfall intensity.
Identifiers: *Storm sewers, Urban drainage, *Surface permeability, Storage tanks.

In this Code of Practice on drainage, recommendations are made for the collection and disposal of rain water and subsoil water, particularly by sewers and drains from small housing estates and individual dwellings. Factors to be considered in the design of surface-water drainage systems so that pipes are self-cleaning are the intensity and duration of rain fall and permeability of surfaces. Procedure is given for disposal of water in sewerage system or to soakaways, streams, or storage vessels. Subsoil water is defined as the portion of rainfall that is absorbed in the ground and its drainage is required to increase the stability of the surface and workability of soil and to reduce flooding. The laying of field drains and mole drains is dealt with in relation to local conditions.
W69-01765

A GUIDE FOR ENGINEERS TO THE DESIGN OF STORM SEWER SYSTEMS, PREFACED BY THE REPORT OF THE JOINT COMMITTEE ON RAINFALL AND RUN-OFF OF THE ROAD RESEARCH BOARD AND THE MINISTRY OF HOUSING AND LOCAL GOVERNMENT.

Dep Sci Indus Res, Road Res Lab, London, Road Note No 35, 1963.

Descriptors: *Design, *Hydrographs, *Hydraulic properties, Sewers, Pipes, Computer programs, *Runoff, *Rainfall intensity.
Identifiers: *Storm sewers, *Lloyd-Davies formula.

This publication is intended to guide engineers in the use of the 'rational' (Lloyd-Davies) formula and the Road Research Laboratory hydrograph method (see Wat. Pollut. Abstr., 1962, 35, Abstr. No. 2151) for designing storm sewage systems. The 'rational' formula is recommended for use in areas where the diameter of the largest sewer is unlikely to exceed 24 inches, while the R.R.L. hydrograph method is applicable to all areas. The calculations involved in the hydrograph method are carried out by means of an electronic digital computer. Data on rates of rainfall and the hydraulic characteristics of sewer pipes are included. The publication is prefaced with a report of the Joint Committee on Rainfall and Run-off of the Road Research Board and the Ministry of Housing and Local Government, dealing with origins of the research, constitution and terms of reference of the committee, and the work being carried out.
W69-01766

SMALL UNDERGROUND DRAINS AND SEWERS: I AND II.

Dept of Scientific and Indus Res, Build Res Sta, Dig Nos 124 and 125, 1959.

Descriptors: *Design, *Construction, *Sewers.

These Digests, which supersede Digest No. 55 (1953), contain advice on the design and construction of drains and sewers, revised on the basis of recent studies. Part I deals with structural design, and Part II with watertightness, flexible joints, site work, and testing.
W69-01767

STORM DRAINAGE SYSTEMS.
Navy Bureau of Yards and Docks, Washington, D. C., 1956.

Descriptors: *Storm drains, *Storm runoff, Subsurface drainage, *Design, *Construction, *Maintenance.

This revised publication presents in detail basic information on the design, construction and maintenance of storm drainage systems used at naval establishments in the U.S.A. and abroad. Although sub-surface drainage factors are presented, a subsurface system should be required only when excess water cannot be otherwise removed.
W69-01769

MANUAL FOR URBAN PLANNING - CHAPTER V: INDUSTRIAL LAND PLANNING,
J Byron Barber.
ASCE Proc, J Urban Planning Devel Div, Vol 93, No UP3, pp 1-13, Sept, 1967.

Descriptors: *Planning, *Drainage systems, Surface runoff, *Storm runoff.
Identifiers: *Urban drainage.

Two aspects of industrial land planning are presented: (1) The urban planner responsible for ascertaining amounts, kinds, and locations of industrial land in the general plan; and (2) the industrial land planner responsible for selection and formulation of a plan for a specific site for a manufacturing plant. It is emphasized that the principles, objectives, methods, and standards described herein apply to both aspects. Sewage problems are briefly discussed. Costs depend on the characteristics of the land and on the type of industry. Storm drainage and surface runoff should be separated from industrial and domestic wastes.
W69-01770

ECONOMICS OF URBAN DRAINAGE DESIGN,
W. J. Bauer.
ASCE Proc, J of Hydr Div, Vol 88, No HY6, pp 93-114, 1962.

Descriptors: Land use, Design storm, *Storm runoff.
Identifiers: *Urban drainage, *Storm sewers, *Chicago (Ill.), Capacity.

Problem of urban drainage viewed as one of space allocation. Storm sewers need a system of controlling location of volumes of water that occupy space in a watershed during and after periods of excessive rainfall. Principles are illustrated by application to Chicago Metropolitan Area during storm of July 1957. Idea of measuring performance of conveyance system in terms of dollars/cfs in transporting water is introduced and some sewer costs given. Planning criteria for urban drainage given: design storm, future urbanization, multiple-purpose projects, storm sewer capacity, assessing benefits, regulation of use of flood plain.
W69-01771

MANUAL ON URBAN PLANNING - CHAPTER III: RESIDENTIAL LAND PLANNING,
George C. Bestor.
ASCE Proc, J. Urban Planning Devel Div, Vol 93, No UP2, pp 27-92, June 1967. George C. Bestor and Assocs, Inc, Carmel, Calif.

Descriptors: *Planning, Land use, Storm drains, *Drainage systems, *Storm runoff.
Identifiers: *Urban drainage.

Residential land planning is going through an era of drastic change. The creation of a better living environment is a major challenge to planners. Engineers are needed as specialists supporting planning activities, and as qualified planners. Many concepts in planning are being increasingly employed, such as: clustering, density zoning, open space, recreational features. Careful consideration of economics is essential to a successful planning activity. No matter how well planned, a project can fail to obtain approval from sponsors or from governing authorities if it is poorly explained and presented. Storm drainage should be planned in the early stages of a project development. Several methods of dealing with stormwater are outlined.
W69-01772

STORM SEWER TUNNEL IN ST. PAUL,
J. W. Bird.
Civil Eng, Vol 33, pp 51-53, Sept 1963.

Descriptors: *Tunnels, Construction, Construction costs.
Identifiers: *Storm sewers, *St. Paul (Minn.), 'Mole' tunneling.

St. Paul's storm sewer tunnel involved building 4,800 ft. of 10-ft. tunnel with 12-in. walls and 1,200 ft. of 7-ft. tunnel and 900 ft. of 6-ft. tunnel with 9-

in. walls. The cost was $2,120,852. There are three 36-in. one 4-ft., and one 8-ft. dropshafts. Four 10-in. alignment holes were drilled to a depth of 70 ft. below the tunnel. These holes acted as inverted walls and were used to lower the water table and to provide construction needs. A 20-ft. long mechanical mole excavated a 12-ft., 3-in. opening for the 10-ft. tunnel. Excavated material was transported to a slurry box, mixed with water to constitute 20% solids, and pumped out. Dust problems were solved by a water-spray and air-exhaust system. Placing forms and pouring concrete closely followed the excavation. Only 110 to 200 ft. of unlined tunnel was permitted. A pneumatic concrete placing machine was replaced by a Pumpcrete machine that cut concrete placement time in half. Vibrators in the concrete plus some vibration in the forms gave excellent results.
W69-01773

TORONTO CONFRONTS OUTDATED SEWERS,
F. T. Booth, N. Vardin, and G. L. Ball.
Water Poll Control Fed J, Vol 39, No 9, p 1557, Sept 1967.

Descriptors: *Storm runoff, *Water pollution control, Construction, *Overflow, Highways.
Identifiers: *Combined sewers, Toronto (Canada), *Capacity, *Storm sewers.

Toronto's combined sewer system is inadequate to handle the flows generated by storms. A program to correct this problem is now under way. Separation of sanitary waste flows and drainage is required in all new buildings. It was determined that a stormwater capacity of about 1.5 times dry-weather flow provides substantial reduction in pollution from storm overflows without excessive cost. Construction of shallow storm sewers will be undertaken to first intercept road and other land runoff and later to receive separate drainage flows from buildings as redevelopment takes place. The proposed system ultimately will protect against the storm with a return period of one year.
W69-01774

THE MAUNGARAKI DEVELOPMENT,
R. G. Brickell.
New Zealand Eng, Vol 23, No 3, pp 95-100, March 15, 1968.

Descriptors: *Storm runoff, Flood control, Discharge (Water).
Identifiers: *Urban drainage, *Capacity.

A development of hilly land for housing in the Wellington area of New Zealand, known as the Maungaraki Development, is described. Problems arising from the development include finance, erosion control, compaction control, and removal of unsuitable materials. The disposal of stormwater runoff was complicated by the limitation of peak runoffs reaching the main storm-water system (the Western Hills culvert) to the capacity of the culvert. The problem was solved by the use in the two main valleys of flood control dams, which store the flood waters and let them discharge at a controlled rate. The ponds are carefully fenced off and are provided with 'leaks' at a low level, which ensure that they dry out a few days after rain. The second flood control dam, in Percy Creek, was constructed by the Petone Borough Council to a design prepared by Climie, Spencer, and Associates, consulting engineers to the Petone Borough Council.
W69-01775

RETENTION BASIN ELIMINATES NEED FOR COSTLY STORM SEWERS,
F. W. Crane.
Eng News Rec, Vol 143, No 25, pp 38-42, 1949.

Descriptors: *Flood control, *Storm runoff, Pumping.
Identifiers: *Storm sewers, Buffalo (N. Y.), *Storage tanks, Capacity.

To prevent flooding from overloaded storm sewers in Buffalo, New York, it is planned to store excess storm water in a disused quarry which has a capacity of 2,350,000 cu ft. The water will then be pumped gradually into the sewers and so discharged into the creek.
W69-01777

STORM WATER DETENTION IN URBAN AREAS,
Eugene J. Daily.
Pub Works, Vol 92, pp 146-147, Jan 1961.

Descriptors: Storm runoff, Drainage system.
Identifiers: *Urban drainage, *Storage tanks.

Give some cost estimates of savings in drainage systems by using detention basins.
W69-01778

DESIGN STORM HYETOGRAPHS FROM STUDIES OF RAINFALL IN THE WESTERN AREA OF SIERRA LEONE,
E. J. Davies, N. J. Garber, and A. E. Harleston.
J Inst of Water Engrs, Vol 20, No 1, pp 67-74, Feb 1966.

Descriptors: *Design storms, *Drainage systems, *Rainfall intensity, Design, Storm, *Hydraulic design.

In Sierra Leone, the design of stormwater drains, spillways, and similar structures whose geometric and hydraulic properties must be related to precipitation frequency, intensity, and duration has largely been based on conjectural storm characteristics. The object of the study was to produce predesign information applicable to the design of stormwater drains and similar structures.
W69-01779

DESIGN OF SURFACE-WATER SEWERS,
L. B. Escritt.
CR Books Ltd, London, 1964. 64 pp.

Descriptors: *Design.
Identifiers: *Storm sewers, Calculations.

In this monograph, which is largely based on a previous paper by Escritt, L. B., and Young, A. J. M., with modifications in the light of further research, recommendations are made for the economical design of surface-water sewers. After a critical review of previous practice, experience, and research, with particular reference to errors resulting in the considerable over-sizing of sewers, the theory is re-examined in the light of recent field studies, leading to the development of a simple, rapid, and accurate method for designing sewers of more economical sizes. Examples are given comparing the new method with the original Lloyd-Davies method. A list of references is provided.
W69-01781

SURFACE WATER DRAINAGE CALCULATION BY DIGITAL COMPUTER,
J. G. Evans.
Survr, London, Vol 121, pp 1436-1437, 1962.

Descriptors: *Surface drainage, *Computer programs, Runoff, Rainfall intensity.
Identifiers: *Calculations.

The author has devised a computer programme for calculating the drainage requirements of any area (involving pipe sizes not exceeding 33 inches in diameter), based on the conventional Lloyd Davies formula. The computer has been used successfully to record rainfall and run-off measurements for the drainage areas of Cwmbran new town.
W69-01782

CALCULATION OF STORM-SEWAGE TANKS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01783

MAIN DRAINAGE FOR SKELMERSDALE NEW TOWN,
D. H. Garside.
J Instn Munic Engrs, Vol 93, pp 26-27, 1966.

Descriptors: Sewers, *Hydrographs, Sewage treatment, Sewage effluent, Design.
Identifiers: *Combined sewers, *Sewer separation, *Storm sewers.

The sewerage system for Skelmersdale New Town, Lancs., has been designed on a separate system and, wherever possible, existing combined sewers will be replaced by separate foul and surface-water systems. After making a comparison between the Road Research Laboratory Hydrograph, and the Lloyd-Davies method of design for surface-water sewers, it was decided to adopt mainly the Lloyd Davies method, but the R. R. L. method was used to produce the hydrographs required for the design of the balancing lakes. There are three types of temporary treatment plant in use: one, a package type extended-aeration plant; the second, an extended-aeration plant using diffused air; and the third, a conventional filter plant using 'Flocor' medium. The final effluent is discharged to the river Tawd. A fourth plant is planned, in the event of further housing development or an increase in industrial flow; this will involve primary sedimentation, land treatment, and clarification of the final effluent through a gravel bed, and the effluent will be discharged to the river Tawd. The main sewage works which is being constructed will provide complete treatment by the activated-sludge process with Simear aeration cones, and the effluent will be discharged to the river Douglas.
W69-01784

MAIN DRAINAGE OF LEYTON,
J. B. Glover.
Chartered Mun Engr, Vol 91, No 2, pp 59-63, Feb 1964.

Descriptors: *Sewers, *Design, Surface runoff, Outlets.
Identifiers: *Storm sewers.

Proposed improvement scheme for sewer system in Leyton, England, includes construction of trunk foul water and surface water sewers and 3 short spurs, and reconstruction of main outfall system. basis of design.
W69-01786

MANUAL ON URBAN PLANNING - CHAPTER VI: COMMUNITY FACILITIES PLANNING,
Herbert A. Goetsch.
ASCE Proc, J Urban Planning Devel Div, Vol 93, No UP3, pp 15-42, Sept 1967.

Descriptors: Sewage treatment, *Flood control, *Planning, Storm runoff, *Drainage systems.
Identifiers: *Urban drainage.

Community facilities are those buildings, works and land areas which are devoted to public or semi-public uses. Included in this catagory are public works and utilities to provide water, power, heat, light, communications, sewage treatment, flood control, and transportation. In planning for community facilities, the urban planner must consider population characteristics and projections, present and future land use, local governmental structures, climate, topography, soil, and vegetation. He must consider a community's objectives and financial ability, as well as the standards of the using agencies. Community facilities may be provided by a local community alone, jointly by several units of government, by higher levels of government, by utility companies, and by private and semi-private agencies. These facilities should be planned jointly since their uses are often complementary and space can be conserved. Problems of flood control and stormwater drainage systems are discussed. Providing adequate stormwater drainage must be considered an important part of urban planning. Economic and engineering aspects of the problem are outlined.
W69-01787

CONSIDERATION OF STORAGE CAPACITY IN STORM-WATER SEWERS,
J. F. Gruhler.
Gesundheits-Ing, Vol 84, 1963.

Descriptors: Design, *Instrumentation, *Flood control, *Storm runoff.
Identifiers: *Storm sewers, Capacity.

The author describes the design of a storm-water sewer equipped with special throttles which can be arranged so as to use the total storage capacity of the sewer and at the same time control the volume of storm water leaving the system to avoid flooding. The exact position and size of these throttles must be determined experimentally, since there is at present no known method for calculating them. The principle of the design is based on the establishment of equilibrium conditions, the flow of storm water entering the system being equal to the storage capacity of the system minus the storm water leaving it, and this depends on the sewer being filled to a certain depth.
W69-01788

ON-THE-SPOT TESTS CHECK GUTTER CAPACITY,
G. H. Hamlin, and J. Bautista.
Am City, Vol 80, No 4, pp 94-6, April 1965.

Descriptors: Flow measurement, *Surface runoff, *Overflow, Design storm, *Inlets.
Identifiers: *Street gutters, *Capacity.

Water-carrying capacity of street gutters in San Leandro, Calif was tested and it was found that practical flows are 1/2 to 1/4 of maximum calculated flows; measurements show that overflows occur substantially below maximums found in tables or calculated by formula; overflows are caused by vehicles parked at curb and driveway openings; tests also measured curb inlet and grating performance; catchbasins are now installed wherever design-storm flow reaches half-way up vertical curb face on all street grades up to 5%.
W69-01789

THE USE OF LAKES IN CONNECTION WITH SEWAGE DISPOSAL,
L. B. Escritt.
Water Waste Treatment J, Vol 7, 1959.

Descriptors: *Surface runoff, *Storm runoff, Outlets, *Flow control, *Lakes, Sewage treatment.
Identifiers: *Capacity, Great Britain.

The author discusses the discharge of partially-treated sewage and of storm water to lakes. Experiences in various countries are quoted, and it is concluded that, with reasonable precautions, lakes could be used in England for the storage of surface run-off without causing nuisance. The design and installation of a module to regulate the outflow from the storage lake to a stream is discussed, and a method and formulae are given for calculating the required storage capacity of a lake in terms of the frequency of storm and rate of outflow from storage.
W69-01814

PROBLEMS IN THE PLANNING OF SEWAGE WORKS,
A. Horler.
Schweiz A Hydrol, Vol 19, 243, 1957.

Descriptors: *Sewage effluent, Sewage treatment, *Overflow, *Storm runoff, *Water pollution.
Identifiers: *Storage tanks, *Combined sewers.

The planning of sewage disposal should be based on topographical and not political divisions. Methods of determining the amount of sewage are described. Combined and separate sewerage systems are compared, and the effect on the receiving stream of storm overflows and the improvement obtained by stormwater storage tanks are discussed. The amount of storm water which should receive complete treatment is then considered.
W69-01824

AQUIFER RECHARGING,
L. T. Hunziker.
Wat Sewage Works, Vol 111, pp 203-205, 1964.

Descriptors: *Groundwater recharge, *Storm runoff, Water pollution.

In a review of recharging of aquifers, various methods are described including diffusion wells and seepage lagoons using settled storm water. The quality of the water for recharge, geological conditions and the dangers of pollution are discussed briefly.
W69-01826

SLUDGE DEPOSITS IN STREAMS FROM STORM WATER OUTLETS,
W. Kiefer.
Neue Deliwa Z, Vol 3, p 71, 1959.

Descriptors: *Storm runoff, *Overflows, *Sewage sludge, Waste dilution.
Identifiers: *Combined sewers, Storage tanks.

The author describes by means of an example a method for estimating the effect of storm-water overflows on sludge deposits in streams. From comparison of overflows of different types it appears that overflows from combined sewerage systems with five-fold dilution add, on a yearly average, less load to the stream than separate systems. Use of storm-water sedimentation tanks, the ideal solution, is not always possible. In general it is unnecessary for such tanks to have a retention period of more than 10 min. The self-purifying power of the stream must be taken into consideration.
W69-01830

OVERFLOWS FROM COMBINED SEWERS IN WASHINGTON, D C,
G. J. Moorehead.
J Water Poll Control Fed, Vol 33, 711, 1961.

Descriptors: *Overflow, *Storm runoff, Estuaries.
Identifiers: *Combined sewers, *Sewer separation, *Washington, D.C., Potomac River.

The older part of Washington, D.C. is served by a combined sewerage system which discharges a mixture of sanitary sewage and storm water into local streams and the Potomac river during each nominal rainfall, while overflows of sanitary sewage sometimes occur during hot dry weather. After a review of the development of the sewerage system, the author outlines a study which was carried out recently to determine the percentage of sanitary sewage flow which is discharged through storm-water overflows. As a result of the study it is planned to provide some separation of sanitary and storm-water sewers, with the majority of the existing storm-water overflows on the combined system remaining in limited acceptable service. This is expected to reduce the amount of sanitary sewage discharging to the watercourses in the area from 3.3 percent to 0.4 percent of the total flow.
W69-01839

THE PERMISSIBLE DILUTION AT STORM WATER OUTLETS,
W. Scharfe.
Wasserw--Wass Techn, Vol 5, p 243, 1955.

Descriptors: *Storm runoff, *Overflow, Outlets, Construction, Water pollution.
Identifiers: *Dilution, Storage tanks.

The author points out that a dilution ratio for storm water overflows of 1:7 may not in all circumstances afford protection to the stream. Local rainfall, by stirring up deposits, may result in the discharge of a liquid more concentrated than normal sewage. Special attention must be paid to the construction of the outlets and to the provision of retention tanks. Increasing the ratio would give sewers of uneconomic size.
W69-01853

BALANCING TANKS AND POUNDS IN THE SURFACE WATER DRAINAGE SYSTEM OF HEMEL HEMPSTEAD,
T. H. Carden.
J Inst Munic Engrs, Vol 93, pp 24-25, 1966.

Descriptors: *Surface drainage, *Drainage systems, *Discharge (Water), *Automatic control.
Identifiers: *Storage tanks, *Urban drainage, Capacity.

The author describes further improvements to the new surface-water drainage system already in operation in Hemel Hempstead, Herts. A further pound is under construction to deal with run-off from one of the new development areas and discharge to the river Gade will be regulated by automatic switches; a further balancing tank is also under construction in the Ver catchment area, with a capacity of 1 1/2 mil.ft3. The balancing tanks and their functions are described and it is suggested that considerable saving can be achieved by the use of a storage unit in suitable drainage schemes where existing facilities for disposal are inadequate.
W69-01868

URBAN HYDROLOGY - REDIRECTION,
D. Earle Jones.
Civil Eng - ASCE, Vol 37, No 8, pp 58-62, Aug, 1967.

Descriptors: *Drainage systems, Storm runoff, *Land use.
Identifiers: *Urban hydrology, *Urban drainage.

Inaccuracies of present hydrology methods are outlined. An improvement is suggested wherein the fact that cities have two separate and distinct storm water drainage systems, a 'minor' and a 'major' system would be recognized. The minor system consists of carefully designed closed and open conduits and their appurtenances. The major system is the route followed by flood or runoff waters when the minor system is inoperable or inadequate. Cities today are overdesigning the minor systems. A reasonable design would provide that ordinary vehicular access to properties be impaired no more often than once in 2-10 yrs. Wiser use of natural land conditions when developing the land can obviate extensive storm sewer construction. Examples are given of some methods for this wiser use e.g. 'blue-green' land development employing ponds with open space for storm-flow detention.
W69-01885

STORM RUN-OFF FROM URBAN AREAS,
M. V. King.
Proc Insts Civ Engrs, Vol 37, pp 43-56, Pap No 6996, 1967.

Descriptors: *Storm runoff, Rainfall-runoff relationships, *Sewers, Hydrographs, Drainage systems, Design.
Identifiers: Urban drainage, *Urban hydrology, Surface permeability.

The author describes the development of a mathematical relation between rainfall and run-off in urban areas, taking into account various calculable characteristics of a drainage area and the retention action of a sewerage system as used in the Road Research Laboratory hydrographic method. It is shown that the peak flow for any particular frequency of storm depends on the time of concentration, the effective impervious area, and the total volume of water in the sewerage system at the time of peak run-off; only the last of these is difficult to determine, and for very large areas it is considered adequate to use an approximation. Having determined the retention constant for a drainage system

under particular conditions, it is also possible to draw the complete run-off hydrograph. This method may be used in designing large sewers, but is not considered suitable for small ones.
W69-01886

ECONOMIC STUDY OF URBAN AND HIGHWAY DRAINAGE SYSTEMS,
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-01887

DETERMINATION OF THE DISCHARGE OF RAIN WATER,
G. Mueller-Neuhaus.
Gesundheits-Ing, Vol 68, pp 143-8, 1947.

Descriptors: *Storm runoff, *Discharge (Water), Sewers.

A graphical method for the determination of the discharge of rain water through sewers taking into account the influence of the gradient and cross-sectional area is described.
W69-01890

STORM WATER DRAINAGE IN THE CHICAGO AREA,
H. P. Ramey.
ASCE Proc, J Hydr Div, Vol 85, No HY 4, Paper No 1995, pp 11-37, 1959.

Descriptors: *Storm runoff, Outlets, Storms, *Storm drainage.
Identifiers: *Urban drainage, *Chicago (Ill).

From a review of past and recent conditions of flooding in the Chicago area, it is concluded that the present outlet channels are inadequate to handle the run-off during heavy storms. Possible methods of improving the situation are indicated and discussed.
W69-01892

FLOODING FREQUENCIES FOR URBAN DRAINAGE DESIGN,
E. S. Rowe, and E. D. Storr.
Australian Road Res, Vol 2, No 10, pp 24-30, Dec 1966.

Descriptors: *Rainfall intensity, *Storm runoff, *Design, Pipes, *Drainage systems, *Highways.
Identifiers: *Urban drainage, Sydney (Australia).

Effects on expected rainfall intensity, run-off, pipe sizes and cost, of using different flooding frequencies for road drainage design are illustrated for situation in Sydney, Australia.
W69-01893

THE HYDROLOGY OF URBAN RUNOFF,
A. L. Tholin, and Clint J. Keifer.
ASCE Proc, J Sanit Eng Div Vol 85, No SA2, p 47, 1959.

Descriptors: *Rainfall-runoff relationships, *Design storm, *Land use, Sewers, *Hydrographs, *Design, Runoff.
Identifiers: *Urban hydrology.

Presented in this paper is a detailed study of rainfall-runoff relationships in urban areas based upon a 'Design Storm' for three hours duration. Several types of uniform land use with various values of ground slope and depression pondage have been studied. Based on the sewer hydrographs, a series of 'easy-to-use' design charts are presented.
W69-01897

PROBLEMS OF WATER DISCHARGE IN URBAN AREAS,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01899

RUNOFF ESTIMATION FOR VERY SMALL DRAINAGE AREAS,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01900

PROGRESS REPORT ON THE STORM DRAINAGE RESEARCH PROJECT, JULY 1, 1958, TO JUNE 30, 1959,
Johns Hopkins Univ., Dept. Sanit. Eng. Water Resour., Baltimore.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01902

SURFACE WATER DRAINAGE--REVIEW OF PAST RESEARCH,
L. H. Watkins.
Instn Mun Engrs, Vol 78, No 4, pp 301-20, Oct 1951.

Descriptors: *Drainage, *Design, *Surface runoff, Sewers, *Rainfall intensity.
Identifiers: Great Britain, United States, Calculations, *Surface permeability, *Sewer infiltration.

Critical review of principal investigations carried out on drainage in England and U. S.; methods for designing surface water sewers; methods of obtaining design intensities of rainfall by means of local records kept over many years; runoff reaching sewer, expressed by impermeability factor of drainage area; American development of curves showing amount of infiltration.
W69-01904

THE DESIGN OF URBAN SEWER SYSTEMS. RESEARCH INTO THE RELATION BETWEEN RATE OF RAINFALL AND THE RATE OF FLOW IN SEWERS,
L. H. Watkins.
D S I R Road Res Tech Pap No 55, London, 1962.

Descriptors: *Design, Sewers, *Rainfall-runoff relationships, Runoff, *Instrumentation, Storms, *Hydrographs, *Computer programs.
Identifiers: *Urban drainage, *Surface permeability.

A report is given of research carried out by the Road Research Laboratory on the relation between the rate of rainfall and the rate of run-off from urban areas, principally intended to lead to a method for calculating the rate of run-off in sewerage systems that would be accurate and reliable under as wide a range of conditions as possible. Rainfall and run-off were recorded at 12 experimental catchment areas, representing a wide range of sizes, types of development, locality, and other variables; and the rates of run-off calculated from the recorded rates of rainfall by 5 different methods were compared with the recorded rates of run-off. Descriptions are included of the experimental catchment areas and of new recording instruments which were developed for use in these investigations. A total of 286 storms was analysed and it was concluded that the Rational (Lloyd-Davies), Tangent, and Modified Tangent methods for calculating run-off were unreliable for use in the design of sewerage systems, although the Rational method could be used for relatively small areas, such as housing estates and villages, where there are no sewers larger than about 24 inches in diameter. The usual Unit Hydrograph method was also unsuitable for the design of urban sewerage systems owing to difficulties in determining the shape of the unit hydrographs. The Road Research Laboratory therefore devised a new hydrograph method which is reliable under all conditions and will be used in conjunction with an electronic digital computer. It was also concluded that in calculations for the design of sewers, subject to some qualifications in exceptional circumstances, the whole area of paved surface in an urban area should be considered impermeable, and the unpaved areas should be considered completely pervious.
W69-01905

A METHOD OF URBAN DRAINAGE DESIGN FOR REGIONS OF HIGH RAINFALL INTENSITY,
I. R. Wood.
Civ Eng Trans Instn Engrs, Australia, CE1, No 1, p 38, 1959.

Descriptors: *Rainfall intensity, *Design, *Drainage system, *Storm runoff, Design storm, *Hydrographs.
Identifiers: Urban drainage, *Surface permeability.

The author considers that the Rational Method is unsuitable for the design of suburban drainage systems in regions where the design intensity is so high that run-off occurs not only from the impervious area but also from the pervious area, such as lawns and gardens. He suggests that a better method would be to determine a design storm pattern, subtract a loss rate curve, and translate the excess rain into hydrograph form using overland flow equations. The application of the method to conditions in Canberra is described. Approximations are suggested to make it possible to use the procedure for routine design.
W69-01910

HARVARD GULCH FLOOD CONTROL PROJECT,
K. R. Wright.
ASCE-Proc (J Irrigation and Drainage Div), Vol 93, No IR1, paper 5132, pp 15-32, March 1967.

Descriptors: *Flood control, *Model studies, Intakes, *Design, Construction.
Identifiers: *Urban hydrology.

Planning, design, and construction of major urban flood control project is presented; emplasis is placed on flood hydrology investigations used as basis for sizing of culverts, open channels, and structures; information is given on model testing of inlet structure to assure control of rate of flood waters entering outfall culvert; techniques for designing open channels, both concrete and grass-lined, are described; underflow pipes were used to carry normal low flows; planning of construction schedule by design engineer is described, together with methods of construction and results of alternate bids for large diameter concrete pipe and concrete box culvert.
W69-01911

RETARDATION OF DISCHARGE IN PUBLIC WATERS WITHIN THE AREA OF A COMMUNITY,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01920

KRUPA V FARMINGTON RIVER POWER CO (FLOODING BELOW DAM).

147 Conn 153, 157 A 2d 914 (1959).

Descriptors: Dikes, *Flood damage, Dam construction, *Dam failure, Building codes, Historic flood, Dams, Maximum probable flood, Rainfall-runoff relationships, Watersheds (Basins), Permits, Legal aspects, Floods, *Connecticut, Judicial decisions.
Identifiers: Farmington River, Flashboards.

Plaintiffs owned a farm on the Farmington River about 800 feet below defendant's dam. The farm was extensively damaged when a dike and flashboards which the defendant maintained in conjunction with the dam gave way during the disasterous floods of August, 1955. Plaintiffs based their cause of action in negligence, breach of contract, and nuisance. Defendant had not acquired proper state authorization to build the dam in 1925, but this violation of statute was not actionable because it was not shown to be the proximate cause of the injury. In 1950 the state board for the supervision of dams and dikes did approve of alterations to the headworks and the dikes. There was no error in the lower court's conclusion that the damage was not

caused by any negligence of the defendant but by an act of God. (McDermott-Fla)
W69-01927

TURNER V WASHINGTON SUBURBAN SANITARY COMMISSION (EASEMENTS AND DISCHARGE OF SURFACE WATERS).

221 Md 494, 158 A 2d 125.

Descriptors: Judicial decisions, *Maryland, *Easements, *Surface runoff, Surface drainage, Water injury, Storm drains, Sewers.

Plaintiff owned property over which a public highway ran, pursuant to an easement. The easement was granted when the area was rural in nature. When the area became suburban, the county built a sanitary sewer and storm drainage system along the highway. Plaintiff brought suit, claiming damages and injunctive relief, on the grounds that the sanitary sewer constituted an additional compensable servitude and that the storm drain concentrated and increased the flow of surface water onto his property, leaving silt and debris deposits. The court held that the laying of the sanitary sewer was within the original easement, and no compensation was necessary. However, the increased discharge of surface water, above the natural flow, was clearly actionable, and the trial court should have granted injunctive relief. (Williams-Fla)
W69-01928

JONES V DES MOINES AND MISSISSIPPI RIVER LEVEE DIST NO 1 (LEVEE DISTRICT'S LIABILITY FOR OVERFLOW).
369 S W 2d 865-869 (Ct App Mo 1963).

Descriptors: Natural streams, *Missouri, *Levees, Drainage systems, *Drainage districts, Pumping plants, Legal aspects, Boundaries (Property), Flooding, Seepage, Surface runoff, Standing waters, Overflow, Soil structures, *Ditches, Mississippi River.
Identifiers: Slough, Levee district.

The plaintiff, owner of property lying adjacent to and in a slough, filed suit against the defendant levee district for damages caused to his land by flooding and an injunction to prevent water from standing thereon. He contended that the district had no right to drain surface water from the surrounding area into the slough and should therefore be held liable for the resulting damage. The trial court denied relief. On appeal it was held, as to the land lying within the slough, that the evidence established that the slough was a natural watercourse thereby entitling the district to collect surface waters and to allow them to flow into that natural draining channel where they would otherwise naturally go. It was further held, as to the plaintiff's property lying outside the slough, that no evidence had been presented to show that the overflows complained of were caused by the defendant's levee. To the contrary, it was established that the water would have overflowed plaintiff's land more often had it not been for the defendant's pumps and levee. (Geraghty-Fla)
W69-01932

EXTINGUISHMENT BY PRESCRIPTION OF NATURAL SERVITUDE FOR DRAINAGE OF SURFACE WATERS,
L. C. Warden.
22 A L R 2d 1047-1059.

Descriptors: *Prescriptive rights, *Surface drainage, Drainage water, Easements, Legal aspects, *Obstruction to flow, Barriers, Natural flow doctrine, Land tenure.
Identifiers: *Servitude.

The right to be free from drainage or natural flow of surface waters may be acquired by prescription. Once the prescriptive right to obstruct the natural flow of water has been acquired, the height of the obstruction may not be increased over the height of the original obstruction. The taker of a prescriptive right to obstruct the drainage of water must benefit from the result. To extinguish a servitude for drainage of surface waters by prescription, there must be an adverse use by the servient tenement against the owner of the dominant tenement. The prescriptive period does not begin until a right of action arises, but no actual damage need be shown for extinguishment of servitude by prescription when the obstruction of the flow is on the servient tenement, the dominant owner must know about the adverse use. The obstruction must also be continuous and uninterrupted. One claiming extinguishment of servitude by prescription has the burden of proving it. (Sisserson-Fla)
W69-01936

SEC 5E TO ISSUE LICENSE FOR APPLICATION OF CHEMICALS TO WATERS FOR CONTROL OF AQUATIC NUISANCES, ETC. SEC 5F TO CONTROL ALGAE, WEEDS AND AQUATIC NUISANCES IN CERTAIN BODIES OF WATER, ETC.

Mass Ann Laws ch 111 Secs 5E, 5F (1967).

Descriptors: *Massachusetts, *Legislation, Administrative agencies, Plant growth regulators, *Chemicals, Algae control, Weed control, *Aquatic weed control, Nuisance algae, Permits, Ponds, Public health.

Sec 5E provides that no person shall use chemicals in a body of water to control algae, weeds or other aquatic nuisances without first obtaining a license from the Department of Public Health. Such license is valid for two years and may be renewed. It is not transferable or assignable and may be revoked for cause. A board of review is created to hear appeals from decisions of the Department. The Department is authorized to establish rules and regulations for the issuance of such licenses. A penalty is provided for violation of the act. Public employees and owners of private ponds are exempted from the act. Sec 5F authorizes the Department of Public Health to control weeds and algae in such bodies of water as it deems necessary. Public hearings and cost estimates are established to determine the necessity of such projects. (Williams-Fla)
W69-01937

WESTBURY REALTY CORP V LANCASTER SHOPPING CENTER, INC (ARTIFICIAL USE OF LAND GIVES RESPONSIBILITY FOR INCREASED SURFACE WATER FLOW).
396 Pa 383, 152 A 2d 669-672 (1959).

Descriptors: *Pennsylvania, Judicial decisions, *Surface drainage, *Surface runoff, Reasonable use, Natural streams, *Land development, Rural areas, Land tenure, Developed waters.
Identifiers: Water disposal system.

Appellee was a developer of a shopping center. Appellant was a landowner whose property adjoined appellee's land. Appellant brought an action for damages resulting from an increased discharge of surface water from appellee's land, and to enjoin appellees from disposing of such water and to provide an adequate disposal system. A landowner may increase the flow of surface water through a natural waterway as a result of reasonable improvements to his land. The court held that covering 17 acres of land with non-porous materials was an artificial use of the land, and the developers had to take precautions so as not to place the burden of the increased flow of surface waters on adjacent landowners. (Sisserson-Fla)
W69-01940

ROCKWELL V STATE (HIGHWAY DRAINAGE).

182 NYS 2d 422 (Ct Cl 1959).

Descriptors: *New York, *Highways, Judicial decisions, Surface waters, Drainage, *Surface runoff, Drainage effects, State governments, Road banks, Pipes, Surface drainage, *Culverts, Damages.
Identifiers: Highway drainage.

A state highway, which perpendicularly intersects claimant's barn driveway, was resurfaced and claimant was required to remove a drain culvert which was underneath his driveway at the point of intersection. Because of the removal of the culvert, surface water flowing along a shoulder depression of the highway flows into claimants land and is causing damage to his barn. A state engineer testified that the highway was properly constructed. Claimant's expert testified that the state should have installed a pipe under the driveway to carry the drainage along the highway depression. A state is not liable for damage caused by the discharge of surface water which is the result solely of the grading of streets. However, if the state collects surface water into a single channel causing it to overflow onto adjacent land, the owner has a cause of action. Claimant could not recover because the natural topography of the land was responsible for the flow of water onto his land. The proof was insufficient to show that the state had increased the flow onto the land by artificial means. (Molica-Fla)
W69-01941

NOLAN V CARR (MUNICIPALITY'S LIABILITY FOR SURFACE DRAINAGE).

189 N Y S 2d 82-87 (Sup Ct 1959).

Descriptors: *Cities, *Riparian rights, Controlled drainage, Culverts, Roads, *Surface drainage, Remedies, Legal aspects, Judicial decisions, Ditches, Drainage system, *New York.

Plaintiff filed suit to restrain defendant town from maintaining a roadside drainage system which plaintiff alleged had produced a flooded condition and a deposit of soil and dirt on his land. Evidence presented at trial established that plaintiff's farm was located at the bottom of a natural depression and that surface waters from lands lying north, west and east of it would flow upon his land and collect in pools. Construction of the roadway and drainage system on higher land north of plaintiff's premises was found not to have increased the size of that natural watershed. It did, however, have the effect of collecting and discharging the water in mass which otherwise would have flowed in a diffused state upon the plaintiff's land. The mass discharge of collected surface water by a municipality onto a private owner's land is actionable. Liability, however, is not predicated on the mere discharge in a single point but on proof of damage to the owner's land. The court found the plaintiff had failed to prove damage to his land and that the drainage system did not increase the total amount of water which would ordinarily have flowed onto his land. Furthermore, the existence of a culvert under the road, terminating 12 feet from the plaintiff's land, provided opportunity for the diffusion of the water. The injunction was denied. (Geraghty-Fla)
W69-01942

HOLBROOK V MASSACHUSETTS TURNPIKE AUTHORITY (ACTIONS FOR DAMAGES BY LANDOWNER FOR FLOODING CAUSED BY FILLING LAND TAKEN BY EMINENT DOMAIN).
154 NE 2d 605-611 (Mass 1958).

Descriptors: Judicial decisions, *Massachusetts, *Eminent domain, Flooding, Landfills, *Flood damage, Rain water, *Highways, Administrative agencies, Damages, Ponds, Dams, Pipes, Legislation, Overflow.

Landowner brought a proceeding against the turnpike authority, which had taken part of his land by eminent domain for the construction of a turnpike, to recover for damage to his land as a result of flooding. The flooding occurred after very heavy rainstorms, allegedly because of fill dumped by a

contractor working on the turnpike. The Supreme Court held that the landowner could maintain a proceeding to recover for the damage under the statute creating the turnpike authority, if the damage was due to the performance of the work as authorized, but not if the damage was a result of an act of God, or due to the contractor's negligence or other unauthorized acts or omissions, in which case the landowner was required to seek redress in a tort action. The burden of proof was on the landowner to prove by a fair weight of credible evidence that his land was damaged or destroyed in the carrying out or in the exercise of powers granted the turnpike authority by statute. (Watson-Fla)
W69-01949

BLUMER V WISCONSIN RIVER POWER CO. (LANDOWNER'S SUIT AGAINST DOWNSTREAM DAM OWNER FOR RAISING THE WATER TABLE).
6 Wis 2d 138, 94 N W 2d 149-154 (1959).

Descriptors: Judicial decisions, *Wisconsin, *Dams, *Water table, Moisture content, *Damages, Riparian land, Reservoirs, Downstream, Flooding mosquitoes.

The Supreme Court of Wisconsin affirmed the lower court's decision that the power company was liable for damages to the plaintiff's land caused by the raising of the water table through the operation of a dam. Testimony of laymen who had been familiar with the condition of the property for many years was sufficient to support a finding that the water table had been raised by the defendant's dam and pool. The amount of damages awarded by the trial court could not be changed by the appellant court. The plaintiffs' only choice of getting more damages would be through a new trial, and they did not ask for a new trial. (Watson-Fla)
W69-01950

WISEMAN V TOMRICH CONSTRUCTION CO (ACTION FOR DAMAGES FROM WRONGFUL DIVERSION OF SURFACE WATERS THROUGH STORM DRAIN).
250 N C 521, 109 S E 2d 248-253 (1959).

Descriptors: *North Carolina, Judicial decisions, *Diversion, Natural flow doctrine, Conduits, *Surface waters, Cities, Road construction, Road design, Roads, *Storm drains, Surface runoff, Damages, Abatement, Drainage systems, Pipes.

Defendant developed a subdivision on land adjoining the plaintiffs'. One of the storm drains from a street in the subdivision wrongfully diverted the natural flow of surface water onto the plaintiffs land causing damage. The trial court awarded the plaintiff's damages and the appellate court affirmed. The court stated that because the construction company had built houses, sold lots, and dedicated streets to public use the rights of individual homeowners and the public had intervened to such an extent that the remedy of abatement was not available to the plaintiffs. The court also stated the development of the subdivision including the installation of the storm drain constituted a single wrongful act creating a permanent condition. The acceptance by the city of the street did not constitute a wrongful act, and the plaintiffs' only action available was against the construction company. The fact that the subdivision was developed under the supervision and in accordance with the requirements of the city did not effect the liability. (Watson-Fla)
W69-01953

NANTAHALA POWER AND LIGHT CO. V HORTON (CONDEMNATION VALUE OF RESERVED WATER RIGHTS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01954

AETNA INSURANCE CO. V WALKER (MEANING OF SURFACE WATERS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01955

LETTERMAN V ENGLISH MICA CO. (FLOODING ABOVE DAM).
249 N C 6769, 107 S E 2d 753-757 (1959).

Descriptors: *North Carolina, *Flood damage, Legal aspects, Floods, *Dams, Watercourses, Backwater, Soils, *Operation and maintenance, Sediment control, River bed, Mining, Mine wastes, Mine drainage, Ponds, Easements, Judicial decisions, Silting beds.
Identifiers: Toe River, Still water.

Plaintiff owned land fronting on the North Toe River about one-half mile upstream from defendant's dam. Drainage to plaintiff's land and roadways allegedly resulted when dirt dumped into the river in the course of upstream mining operations flowed downstream to the still water of the dam, raised the bed of the stream, and caused water to back onto plaintiff's property. Plaintiff grounded his cause of action in trespass and negligence, joining the upstream mine owner and the downstream dam owner. Defendant dam owner's demurrer was sustained and plaintiff appealed. This court affirmed. The proprietor of a dam, though not an insurer of the safety thereof, is required to exercise ordinary care in maintenance and operation so as to avoid injury to others occasioned by causes reasonably to be anticipated and guarded against. However, Plaintiff failed to allege sufficient facts to show that the injuries sustained were directly and proximately caused by any act or emission of the defendant. (Bozarth-Fla)
W69-01956

CORRINGTON V KALICAK (LIABILITY FOR CAUSING FLOOD BY OBSTRUCTING A STREAM).

319 S W 2d 888-895 (Ct App Mo 1959).

Descriptors: *Missouri, Judicial decisions, Legal aspects, Streams, *Obstruction to flow, Flooding, *Flood damage, Flash floods, Cities, Bridges, *Excessive precipitation.

Plaintiffs brought suit for damages allegedly caused by a city and a company with which it contracted to build a bridge. In connection with this project, the company had erected scaffolding in the watercourse over which the bridge was to be built. During a heavy rain, logs and debris collected against the scaffolding, causing the stream to overflow and damage plaintiffs' property. On appeal, the St. Louis Court of Appeals held that the damage was caused by the obstruction and not by an Act of God. The court held that the fact that the bridge's construction was a public work would not excuse a trespass committed in the course of the work. This was misfeasance within the course of the city's powers, and therefore it could be held liable in an action for trespass for direct injury, regardless of whether it was intentional or negligent injury. (Williams-Fla)
W69-01958

DESIGN AND OPERATION OF LOW-HEAD SELF-PRIMING SIPHONS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01964

NAVIGABLE WATERWAY BETWEEN DEMOPOLIS AND TENNESSEE RIVER AND FLOOD CONTROL PROJECTS ON TRIBUTARY STREAMS OF TOMBIGBEE RIVER.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01966

WATERSHED CONSERVANCY DISTRICTS.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01969

ERECTION OF DAMS FOR MILLS, GINS OR FACTORIES.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01970

WELLS, CISTERNS: CARE OF.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01972

ALLIANCE FOR CONSERVATION OF NATURAL RESOURCES IN PINELLAS COUNTY V FUREN (APPEALING DECISION OF NAVIGATION AUTHORITY ALLOWING FILL OF PORTION OF BAY).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01990

ANDERSON V U S (CLAIM FOR DAMAGES TO FARM LANDS ALLEGEDLY CAUSED BY ESTABLISHMENT OF WILDLIFE REFUGES).
174 F Supp 945-949 (Ct cl 1959) 5 p.

Descriptors: Judicial decisions, *Federal government, Damages, *Flood damage, Administrative agencies, Wildlife management, Rain, Migratory birds, Topography, Snow, *Natural flow doctrine, Drainage, Runoff, Watersheds (Basins), *North Dakota.

This was an action by owners and farm operators of land involved for damages for losses from flooding which they said was the result of activities of the Fish and Wildlife Service. The service obtained easements and flooded some of the low areas adjacent to the land in question for migratory wildlife refuges. The court stated that one could not lawfully divert water from its natural watershed or by artificial structures cause water to flow in another direction or over lands on which it would not otherwise have gone if to do so would deprive a landowner of the use or fruits of his property. However, the court added that it was necessary to prove that any damage suffered was the direct result of the activities complained of and there is no liability for damages caused by flooding which would have occurred regardless. The court held that the evidence presented established that the flooding of the land was caused by adverse weather conditions, topography of the area, and inadequate outlets for the lake rather than as a result of the activities of the Fish and Wildlife Service. (Watson-Fla)
W69-01993

JONES V UNITED STATES (RUNOFF DAMAGE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01994

ATTORAM REALTY CORP V TOWN AND COUNTRY BUILDERS, INC (DAMAGE FROM DISCHARGING SURFACE WATERS).
8 App Div 2d 936, 190 NYS 2d 499-501 (1959).

Descriptors: *New York, Judicial decisions, Appeals, *Drainage, Gutters, Rain water, *Surface runoff, Precipitation excess, Discharge, *Damages, Erosion, Gullies.

Town and Country Builders, appellants, contest a judgment (1) enjoining them from collecting surface waters on their land and discharging such waters onto respondent's land; and (2) awarding respondent money damages. Appellants, in connection with developing their land, built an 18-inch drain and two 21-inch drains to drain excess rain

water from their land. Respondent claimed that the increased flow caused by these drains resulted in forming gullies on its property. The judgment was reversed, without costs, to ascertain the damage to respondent's land from the difference in the value of the land before and after the installation of the drains, and to provide injunctive relief if the damages awarded are not paid within a reasonable time. The court found that a mandatory injunction would be oppressive. The measure of damages was changed, because the lower court's finding that the gullies were caused solely by the drains was against the weight of the evidence. (Childs-Fla)
W69-01995

GAGNER V CARLSON (RIGHTS APPURTENANT TO FLOWAGE EASEMENT).
150 A 2d 302-308 (1959) 146 Conn 288.

Descriptors: Judicial decisions, *Connecticut, *Easements, Ponds, Beds, Recreation, Dams, Flooding.

A portion of plaintiff's land which abutted a large pond was subject to an easement which allowed defendant to raise the height of a dam on plaintiff's property and to flood the surrounding land. Defendant obtained an injunction against interference by the plaintiff with his use and enjoyment of the pond for recreation and also against interference with his entrance on plaintiff's property to repair a break in the bank of the pond. Defendant's right to enter plaintiff's land for the repairs arises by implication from the grant of the easement because it is necessary for the full enjoyment of the easement, even though the break occured on land not subject to the easement. The easement was acquired by grant and not by prescription and contains no language limiting its purpose. Therefore it is broad enough to permit the defendant to make any reasonable use of the land to which the easement is appurtenant including recreation. (Molica-Fla)
W69-01997

CROLEY V DE WITT (OBSTRUCTION OF DRAIN).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01999

4B. Groundwater Management

FIELD OBSERVATIONS COMPARED WITH DUPUIT-FORCHHEIMER THEORY FOR MOUND HEIGHTS UNDER A RECHARGE BASIN,
Agricultural Research Service, Fresno, Calif.
W. C. Bianchi, and E. E. Haskell, Jr.
Water Resources Res, Vol 4, No 5, pp 1049-1057, Oct 1968. 9 p, 4 fig, 5 tab, 16 ref.

Descriptors: Hydrographs, *Pit recharge, *Water level fluctuations, *Mathematical studies, *Dupuit-Forchheimer theory, Infiltration, Observation wells, Water levels.
Identifiers: Groundwater mounds.

A theoretical analysis, using the Dupuit-Forchheimer assumptions, of rising and falling hydrographs of the groundwater mound beneath the center of square and circular recharge basins, is presented. The analysis was field tested using 2-acre square ponds in Panoche clayloam. Observation wells were arrayed radially along the perpendicular bisectors of the sides of the ponds. The analysis was found to be generally acceptable. Discrepencies between calculated and observed values are due to imprecision in measuring or estimating physical parameters. (Knapp-USGS)
W69-01655

USE OF STORM RUNOFF FOR ARTIFICIAL RECHARGE,
J. E. Berend, M. Rebhun, and Y. Kahana.
Am Soc Agric Engrs-Trans, Vol 10, No 5, pp 678-84, 1967.

Descriptors: *Storm runoff, *Water quality, *Instrumentation.
Identifiers: Surface permeability, Israel.

Utilization of flood water both as source of additional supply and as means of introducing low-salinity water into water supply system in Israel; studies were carried out on development of adequate research methods and of suitable instrumentation, and in such manner as to make them also useful in planning reclamation of sewage effluents; studies of quality of waters and their response to treatment, infiltration capacity of spreading grounds and analysis of infiltration phenomena, and process of clogging, its prevention and corrective measures are discussed.
W69-01864

EXPERIMENTS IN WATER SPREADING AT NEWARK, DELAWARE,
D. H. Boggess, and D. R. Rima.
U S Geol Surv Water Supply Pap 1594-B.

Descriptors: *Storm runoff, *Groundwater recharge.
Identifiers: Surface permeability, Newark (Del).

Results are given of further experiments at Newark, Del., on the possibility of using excess storm run-off to recharge ground water (see Wat. Pollut. Abstr., 1961, 34, Abstr. No. 761). Although nearly 500,000 gal of water were spread in an infiltration ditch near the municipal well field and allowed to seep into the sub-surface, there was no indication that any appreciable amount of water reached the producing aquifer. Instead, a perched zone of saturation was created by the presence of an impermeable or slightly permeable bed above the water table. This layer barred the downward movement of water so effectively that in less than one day the apex of the perched zone rose about 10 ft to the level of the bottom of the infiltration ditch, and as more water was added the mound of saturation spread laterally. From these experiments it was concluded that the principal aquifer at Newark would not be benefited by spreading water in shallow infiltration ditches or basins, although the absorptive capacity of the unsaturated materials which occur at shallow depth is sufficient to permit the disposal of large volumes of storm water. However, the well field might be recharged by other methods; one possible solution would be a shallow basin to store excess storm water both of the land surface and in the permeable beds at shallow depth, and within this basin recharge shafts could be constructed to expose the top of the producing aquifer and allow water from the surface and from the sand and gravel bed to infiltrate through the shaft and into the aquifer below.
W69-01865

DISPOSAL OF STORM WATER BY GROUND WATER RECHARGE,
G. Congguy.
Calif Dept Water Resources-Biennial Conf on Ground Water Recharge and Ground Water Basin Management-Proc, 1963. 10 p.

Descriptors: *Storm runoff, *Groundwater recharge, *Highways.
Identifiers: *Capacity.

Utilization of excavated pit type of recharge basin for collection and disposal of storm water from roadways in various areas of San Joaquin Valley, Calif; basins vary in size from 1-6 acres, depending on storage requirement, and are located close to roadway; usually, basins are used as material sites for roadway embankment material.
W69-01877

SARGENT V GAGNE (EASEMENT TO USE OF WATER SUPPLY ON THE LAND OF ANOTHER).

147 A 2d 892-901 (Vt 1958).

Descriptors: Judicial decisions, *Vermont, *Springs, Aqueducts, Pipelines, *Easements, *Water supply.

Both parties claimed ownership of a spring on the defendant's property. The court established that the spring belonged to the plaintiff through a deed to his predecessors many years previous. The defendants were enjoined from interfering with the plaintiffs' right to take water from the spring and from interfering with plaintiffs' repair and maintenence of a pipeline from the spring. The court held that the exception of the spring in the grant from the common grantor to the defendants' predecessor in title had the legal effect of carving out and separating the spring from the defendants' farm. The fact that the deed from the defendants' immediate grantors failed to mention such exception did not enlarge the defendants right to the spring. Defendants also had the burden of proving any abandonment of the easement, which they failed to satisfy. (Watson-Fla)
W69-01939

4C. Effects on Water OF Man's Non-Water Activities

EVALUATION OF THE EFFECT OF MINING THE IRON ORE DEPOSITS OF THE KURSK MAGNETIC ANOMALY ON THE FLOW REGIME OF THE OSKOLETS RIVER,
B. M. Dobroumov, I. N. Obraztsov, and B. S. Ustyuzhanin.
Translation from Trudy Gos Gidrol Inst No. 139, 1967, pp 206-223. Soviet Hydrol, Selec Pap No 1, pp 42-56, 1967. 15 p, 5 fig, 8 tab, 2 ref.

Descriptors: *Mine water, *River flow, *Surface-groundwater relationships, *Mine drainage, *Hydrologic budget, Water balance, Infiltration, Induced infiltration, Dewatering, Diversion structures, Waste water disposal.
Identifiers: *Water management measures, USSR, Oskolets River Basin, Chern' River Basin.

The effect on river flow of large-scale pumping for water control in deep iron mines in the USSR is described. In the area of the Mikhaylov iron mine in the Chern' River Basin, mined since 1960, the 1964 water-level depression reached 60m, the cone of depression had a radius of 18 km, and discharge by pumping was 180 liters per sec. Near the Lebedi mine, the largest in the Oskolets River Basin, a cone of depression 10 km in radius and 80 m deep was formed by pumping over 1,600 liters per sec, or about 80% of the normal flow of the river. The cone extends under the river and induces recharge, increasing the need for pumping. A detailed hydrologic budget was computed for the Oskolets River and is presented in tables, graphs, and profiles, The main factors in changing the river's regime are discharge of mine drainage water into the river, diversion of water from the river for municipal and industrial use, decrease in natural groundwater discharge, and induced recharge into the mine-drainage cone of depression. (Knapp-USGS)
W69-01629

MAGNITUDE AND FREQUENCY OF FLOODS IN SUBURBAN AREAS,
R. W. Carter.
U S Geol Surv Prof Pap 424-B, B.9-B.11, 1961.

Descriptors: *Drainage systems, *Hydrographs, Land use, *Infiltration, Peak discharge, *Floods.
Identifiers: *Suburban drainage, Washington, D. C., *Surface permeability.

Suburban development changes two of the basic elements that determine the magnitude and timing of the volume and peak of the flood hydrograph, namely the average infiltration rate (which is decreased because roofs and streets are impervious), and the lag time between rainfall excess and

the flood hydrograph (which is decreased because of storm sewers and improvements to the principal stream channels). The net effect of these changes has been evaluated in the vicinity of Washington, D. C. After analysing the data statistically, it is concluded that for drainage basins larger than 4 square miles in the Washington area the maximum effect of complete suburban development on flood peaks of any recurrence interval is expressed by the ratio flood discharge (suburban): flood discharge (undeveloped)=1.8.
W69-01663

POLLUTION PREVENTION IN NORTHERN IRELAND,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01818

SEDIMENT IN SMALL RESERVOIRS DUE TO URBANIZATION,
H. P. Guy, and G. E. Ferguson.
ASCE Proc, J of Hydr Div, Vol 88, No HY2, 1962.

Descriptors: *Land use, *Sedimentation.
Identifiers: *Urban drainage.

Increasing urban development may cause severe silting in small reservoirs downstream from such developments. A typical example is that of lake Barcroft, near Washington, D. C., where 19 acre-ft or 25,000 tons of sediment have been deposited for each square mile of completed residential construction. Factors affecting sedimentation in urbanized areas are listed; these are similar to those occurring under rural conditions, but are more difficult to evaluate. Material deposited in a reservoir after urban construction will probably be coarser than that associated with rural conditions.
W69-01820

THE POLLUTION OF RUN-OFF FROM URBAN HOUSING ESTATES,
H. E. Kurzweil.
Gesundheits-Ing, Vol 85, 178, 1964.

Descriptors: Runoff, Rainfall-runoff relationships, *Rainfall intensity, *Water quality, *Biochemical oxygen demand, *Dissolved oxygen, *Water pollution, Sewage treatment, *Storm runoff.
Identifiers: *Urban drainage, *Storm sewers.

Based on studies of rainfall and run-off in urban areas, during storms of varying intensity, results are given on the changes in the quality of water from roofs and paved areas, including data on 5-day B.O.D., dissolved oxygen, and organic substances. The discharge of this polluted water to the storm-water sewer or sewerage system is discussed and the author recommends preliminary treatment of this run-off to reduce pollution.
W69-01831

ENVIRONMENTAL EFFECTS OF HIGHWAYS,
M. E. Scheidt.
ASCE Proc, J Sanit Eng, Div, Vol 93, No SA 5, Pap No 5509, pp 17-25, 1967.

Descriptors: *Highways, *Water pollution, Construction, *Surface runoff.

The author discusses the various polluting effects of highways on the natural environment. The greatest source of pollution is erosion during construction of the highway, which can cause considerable damage downstream, and measures to control such erosion are required during the construction of federal and federal-aided highways. Other sources of pollution are chemicals used to melt ice and snow and to control roadside vegetation, spills from vehicles involved in accidents, and run-off from paved areas.
W69-01854

ECONOMIC STUDY OF URBAN AND HIGHWAY DRAINAGE SYSTEMS,
J. W. Knapp.
Johns Hopkins Univ-Dept Sanit Eng and Water Resources-Tech Report 2, June 1965. 175 pp.

Descriptors: *Drainage systems, Design, *Highways, *Runoff, *Flood control, *Model studies, *Intakes.
Identifiers: *Urban drainage.

Characteristics of flood losses are investigated; information collected on cost of drainage facilities and damages in urban areas is analyzed; for highway drainage, interruption of traffic flow is interpreted as major flood damage; mathematical models are developed for solution of specific drainage problems; stimulation is used to describe random effects of runoff and traffic in model for selecting pumping facilities to remove storm water at highway underpass; two models for finding optimum spacing of inlets are developed and solved.
W69-01887

DETERMINATION OF RUN-OFF COEFFICIENTS,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01889

ALLOCATION OF STORM DRAINAGE COSTS,
For primary bibliographic entry see Field 06C.
For abstract, see .
W69-01891

SUBURB MEETS URBANIZATION HEAD-ON,
Ayers, Lewis, Norris, and May, Ann Arbor, Mich.
R. J. Smit, R. R. Robinson, and T. W. Swift.
Water Wastes Eng, Vol 4, No 11, pp 47-9, Nov 1967.

Descriptors: *Design, *Sewers, *Construction costs, Grants.
Identifiers: *Urban drainage, Intercepter sewers.

The doubling of student enrollment since World War II at the University of Michigan has exerted considerable pressure on living facilities in the three surrounding areas, East Lansing, Lansing and Meridian Township. The existing sewage treatment plant was overloaded. The three areas negotiated to divide the costs of a new sewage treatment plant, new on-campus interceptors and new sewer main construction. Design of the main sewer system is discussed. Obstacles in planning and financing of the undertaking are described. Lateral sewers in 12 districts were financed by bonds totalling $1.84 million. In addition some financing was available through federal grants. The total construction costs were about $3.8 million. It is hoped that the lessons learned by this township government in facing the challenge of growth will be useful to other suburban communities with similar problems.
W69-01895

STUDIES OF SEVERE RAINSTORMS IN ILLINOIS,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01896

HYDROLOGIC EFFECTS OF URBAN GROWTH--SOME CHARACTERISTICS OF URBAN RUN-OFF,
A. O. Waananen.
U. S. Geol Surv Prof Pap 424-C, C.353-C.356, 1961.

Descriptors: Land use, Runoff, *Storm runoff.
Identifiers: *Urban drainage, *Urban hydrology.

The author discusses the effects of urban development on flow in streams. The changes in run-off characteristics following urban growth are illustrated graphically. Peak run-off from developed areas may be 3-4 times that from upstream or adjacent natural areas. In urban areas, a substantial part of the run-off occurs during a short period following a storm and the rapid discharge into receiving channels and streams reduces the opportunity for evaporation and transpiration as well as infiltration and percolation.
W69-01903

PRELIMINARY STUDY OF EFFECT OF URBANIZATION ON FLOODS IN JACKSON, MISSISSIPPI,
K. V. Wilson.
U S Geol Survey-Prof Paper 575-D, pp D259-61, 1967.

Descriptors: Land use, *Flood forecasting.
Identifiers: *Urban hydrology, *Urban drainage, Surface permeability.

Comparison of flood-frequency curves for three streams near Jackson, Miss., based on annual maximum floods for period 1953 to 1966, and for another stream for shorter period, indicates that mean annual flood for totally urbanized basin is about 4 1/2 times that of similar rural stream; it further indicates that 50-yr flood for such urbanized basin is about three times that of rural stream.
W69-01907

WATERFRONT RENEWAL IN METROPOLITAN AREAS,
Donald F. Wood.
ASCE Proc, J Urban Planning Devel Div, Vol 93, No UP4, pp 199-213, Dec 1967.

Descriptors: *Drainage systems, Flood control, Water pollution control, Planning, Recreational facilities, Storm runoff, Land use.
Identifiers: *Urban drainage.

Many of our urban waterfronts are blighted because of age and conditions unique to their location, such as vulnerability to flooding or surface water pollution. A range of actions, from simple clean-up to full scale clearance and relocation, can be used to fight waterfront deterioration. Metropolitan and basinwide approaches are needed because frequently an individual city cannot control what happens upstream or on the other side of a river. Federal urban renewal programs help to reduce the local cost. In a metropolitan waterfront renewal program the engineer must determine the condition of all shore line and the costs of repairing or replacing it. New uses can be found for old waterfront structures. Altering the amount of shore line; providing open space and access; reducing flood and storm damage; and renewing for navigational, waterfront industrial and recreational uses are also discussed. Providing adequate storm drainage for the renewal area is an important part of an improvement plan. This drainage system could be designed to improve drainage in a larger area than just the renewal project and the area benefiting can share costs. Aspects to be considered in planning include increased runoff due to development upstream, old dams, dredging of channels and winds. Some solutions are offered.
W69-01909

RUSKIN BROS, INC V STATE (DEBRIS BLOCKAGE OF CATCHBASIN).

8 App Div 2d 895, 187 N Y S 2d 51-53 (1959).

Descriptors: *New York, Judicial decisions, Riparian rights, *Screens, Natural streams, Upstream, *Watersheds (Basins), Culverts, *Obstruction to flow.

The State built a highway passing over a culvert carrying a natural stream which flowed through plaintiff's land. The State installed a screen at the

mouth of the culvert to prevent its blockage by debris coming from upstream. Plaintiff built a catchbasin on his land to lower the level of the stream to permit a covering over a part of his land. Subsequently, the State removed the screen and the debris which passed into the catchbasin caused it to become blocked and as a result plaintiff's cellar was flooded. The State is not liable for merely allowing the stream to flow unimpeded. The accumulation of water was caused by the catchbasin. An upper riparian owner is not chargeable with negligence in allowing debris to flow through his land from above which may cause damage below provided he does not increase the debris in the stream. (Molica-Fla)
W69-01996

4D. Watershed Protection

TIME IN URBAN HYDROLOGY,
G. E. Willeke.
ASCE Proc, J Hydraulics Div, Vol 92, No HY 1, paper 4615, pp 29-31, Jan 1966.

Descriptors: *Rainfall-runoff relationships, Rainfall intensity, Watersheds, *Hydrographs.
Identifiers: *Urban hydrology.

Analysis of lag time (defined as time between centroids of effective precipitation and runoff) from nine small urban watersheds shows that lag time variability is small and that lag time is not correlated with storm intensity; effective precipitation can be routed through storage by Muskingum method to accurately reproduce observed runoff hydrograph; effective precipitation is separated from total precipitation by phi-index; precipitation loss on watershed is closely represented by linear relationship between total storm precipitation and total storm runoff.
W69-01906

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification OF Pollutants

LICKING RIVER AND TRIBUTARIES, OHIO (FLOOD CONTROL AND ALLIED PURPOSES).
Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 337, 182 p, 1968. 1 map, 21 tab, 1 append, 1 attach.

Descriptors: *Multiple-purpose projects, *Flood control, *Recreation, *Channel improvements, Dams, Ohio, Cost-benefit ratio, Water values.
Identifiers: Licking River, Newark (Ohio), Economic development.

In determining the advisability of providing improvements for the assessed water resources needs within the Licking River Basin, Ohio, several reservoirs were considered for both multiple and single purpose development. Only Utica Reservoir on North Fork of Licking River was found to be economically justifiable. The Utica project would provide for the water supply and water quality control needs of the basin until the year 2020, would provide recreation opportunities to some 450,000 visitors annually, and would provide reductions of flood crests along North Fork. To further alleviate the severe and frequent flooding at Newark, several local protection schemes were investigated for three independent areas. Economically feasible projects were developed for the protection of a rapidly expanding residential area along Log Pond Run, for improving the interior drainage facilities behind the existing Federal levee, and for improvement of the North Fork channel. Acting as a system, Utica Reservoir and the improvement of the North Fork channel would prevent 91% of the average annual damages along North Fork in Newark. The diversion plan would reduce average annual damages along Log Pond Run by 73%. Improvement of the interior drainage facilities would eliminate a serious health hazard and would prevent flood damages due to insufficient pumping capacity. The survey report concludes that Utica Reservoir, the Log Pond Run diversion project, improvement of interior drainage facilities of the completed local protection project and improvement of 5,900 feet of the channel of North Fork of Licking River should be added as units in the plan of water resources development for the Licking River Basin to supplement existing projects of the Corps of Engineers.
W69-01647

A HORN FORETELLS SEWER OVERFLOWS.

Amer City, p 58, May, 1967.

Descriptors: *Instrumentation, *Overflow, *Sewers.

A description of an electronic device in use at five lift stations in McPherson, Kan., which warns if sewage levels rise too high is given. When sewage rises too high it contacts an electrode, a light flashes and a horn blows in police headquarters. Device saves about 100 man-hours of work/month. A sketch and wiring diagram are given.
W69-01657

TV SEWER INSPECTION,
Robert H. Brindley.
Amer City, Vol 79, pp 87-89, Jan 1964.

Descriptors: *Equipment, Sewers.
Identifiers: *Sewer inspection.

The television sewer inspection equipment of the Hartford, Conn., Metropolitan District is described in the article. Inspections have proven effective in locating house laterals, finding sewer obstructions, and determining condition of sewers. A crew consists of television operator, forward winch man, and cable guide man. The camera can best be pulled through the sewer by a hand winch that has reduction gears with a pulley and brace mounted in the manhole. A direct-wire intercom with a talk-back speaker provides communication and permits the winch man to keep both hands free. Sewers needing cleaning or flowing over one-third full are not conducive to TV inspection. Difficulties in the use of the equipment have been resolved: camera skids have been modified to prevent fouling of lines; a more powerful camera light has been installed for use in small sewers; work has been rescheduled when radio frequency interference occurred; and fog has been moved through the sewers by a portable blower forcing air into the manhole.
W69-01661

LARGEST SEWER PHOTO INSPECTION,
C. E. Cannon.
Am City, Vol 80, No 1, pp 98-9, Jan 1965.

Descriptors: *Sewers, *Equipment.
Identifiers: *Sewer inspection, *Storm sewers.

Extensive underground photographic survey, carried out at Anchorage, Alaska, to assess damages caused by earthquake, covered 600,000 ft of 8- to 21-in. sanitary and storm sewers; Inspectoline camera equipment and Wayne 3-D Pipeline Survey cameras were employed by two inspection groups; methods followed to determine condition of pipe lines.
W69-01662

MONITORING STORM-WATER OVERFLOWS,
A. D. Caster.
J Water Poll Control Fed, Vol 37, pp 1275-1280, 1965.

Descriptors: *Overflow, *Water pollution control, Instrumentation.
Identifiers: *Interceptor sewers, Cincinnati (Ohio).

A description is given of the system installed at Cincinnati, Ohio, to detect when overflows occur from the sewers as a result of clogging of the interceptors with solid materials during normal dry-weather flow. A signalling device is fitted at each interceptor and the signal is transmitted to the telephone exchange. It is hoped by this means to reduce pollution of the various creeks within the metropolitan area.
W69-01664

NEW INSTRUMENT CAN MEASURE SEWAGE FLOW,
A. E. Cruchley.
Munic Eng, Vol 136, pp 814-815, 1959.

Descriptors: *Flow measurement, Surface drainage, *Sewers, *Flowmeters.

An illustrated description is given of a new instrument, developed by the Road Research Laboratory during investigations on surface water drainage, for recording flow in sewers. The device records variations with time in the rate of sewage flow and the periods of time during which the flow is in excess of certain values selected for particular study. The instrument is composed of a movement recorder and a time totalizer, the latter consisting of a time base and multiple-contact switch-unit within the movement-recorder and a separate box containing a rectifier and a battery of counters.
W69-01665

TEMPORARY FLOW MEASUREMENT IN SEWERS AND DRAINS,
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01667

A FIELD METHOD OF MEASURING AND RECORDING FLOW IN SEWERS,
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-01668

SEWAGE SAMPLING,
L. B. Escritt.
Water and Waste Treatment J, Vol 8, No 10, Nov-Dec 1961.

Descriptors: *Sampling, Instrumentation, *Sewage treatment.

Discussion on the value of sewage sampling points out the care that should be taken whether samples are collected by hand or machine and describes methods used in hand sampling, automatic sampling, and importance of weighted samples. A simple weighted automatic sampler of the type used by the London County Council at outfall works is described in detail. This sampler has no moving parts except a pump and collects 43 samples per day totaling 4 gallons at high flows and 12 samples per day, about 1 gallon of sample, during low flows in proportion to the flow.
W69-01669

METHODS AND EQUIPMENT FOR THE MEASUREMENT OF SEWAGE FLOW,
H. Fathmann.
Wasser Luft Betrieb, Vol 10, pp 668-673, 1966.

Descriptors: *Flow measurement, *Weirs, Instrumentation, *Sewers.
Identifiers: *Calculations.

Quantitative measurements within a definite given time are often required for experimental purposes and operational research. For this purpose tank measurements are employed, using floats and mea-

suring weirs. Stationary calculations on volume of sewage are carried out by measurements in pressure pipe lines according to the Venturi principle or as inductive measurements for the rate of flow.
W69-01670

FLOW MEASUREMENT TECHNIQUES,
G. D. Healy, Jr.
Instruments and Control Systems, Vol 38, No 3, pp 111-15, March 1965.

Descriptors: *Flow measurement, *Flowmeters, Instrumentation, *Sewers.

Review of flow measurement techniques commonly used for water and sewage, volumetric meters, timed volume flow, variable headmeters, pilot tube, orifices, venturi, nozzles and open channel techniques.
W69-01672

A FIELD METHOD OF MEASURING AND RECORDING FLOW IN SEWERS,
C. Thorne Johnston, and Warren Ellis.
Pub Works, Vol 94, No 6, p 124, 1963.

Descriptors: *Flow measurement, *Sewers, Instrumentation, *Flowmeter.

Article describes the use of a snap-ring tube jacked into a sewer pipe in which a bubbler-tube using nitrogen gas transfers flow depth to a recorder. This method requires that a depth-discharge curve be computed for a reach of sewer. Advantage is in cost and elimination of problems of location and operation of devices such as flumes.
W69-01674

DISCHARGES FROM SEPARATE STORM SEWERS AND COMBINED SEWERS,
W. J. Benzie, and R. J. Courchaine.
Water Poll Control Fed J, Vol 38, No 3, p 410, March 1966.

Descriptors: Discharge (Water), *Coliforms, *Chemical analysis, Runoff.
Identifiers: *Combined sewers, *Storm sewers, *Bacteriological sampling.

Discharges from a separate storm sewer system showed mean median bacterial counts per 100 ml of 12 x 100,000, 0.82 x 100,000, and 1.4 x 100,000 for total coliforms, fecal coliforms, and fecal streptococci, respectively. Corresponding figures for discharge from a combined system were 94 x 100,000, 2.7 x 100,000, and 5.8 x 100,000. The ratios of fecal coliforms to fecal streptococci in the combined and separate systems were 4.7 and 0.6, respectively, indicating that the bacteria in the combined system are primarily of human origin, whereas those in the separate system are derived from other warm-blooded animals. Phosphates and nitrates in combined system discharges were about 3 to 4 times greater than contents in discharges from separate systems.
W69-01796

DESCRIPTION OF A COMMUNITY OF MICRO-ORGANISMS IN PURIFIED SEWAGE MIXED WITH RAIN WATER FROM STORM SEWERS,
T. G. N. Dresscher.
Hydrobiologia, Vol 14, 1959.

Descriptors: *Storm runoff, *Sewage effluent, Water pollution, *Chemical analysis.
Identifiers: *Bacteriological sampling, Amsterdam (Holland).

The author gives details of the community of micro-organisms isolated during the period 1953-1958 from a canal to which are discharged storm water and the effluent from the activated sludge plant serving the western part of Amsterdam. Sampling procedures and biological investigations are described and a comprehensive list of organisms isolated during this period is given. The determination of micro-biocoenosis, based on the number of micro-organisms present, is discussed. Results of bacteriological and chemical investigations are also given. The Eijkman test carried out at 45 degrees C and the determination of faecal streptococci showed a decrease in faecal pollution from 1953 to 1957, but pollution increased again in 1958. The average chemical results also showed that pollution was least in 1956 and 1957, and this coincided with a reduction in the numbers of Euglenophyceae and some other organisms.
W69-01809

OPERATING CHARACTERISTICS OF BACTERIAL WATER QUALITY STANDARDS,
Walter Reed Army Inst of Research, Washington, D. C.
D. W. Duttweiler.
Am Water Works Assoc J, Vol 58, No 6, pp 742-50, June 1966.

Descriptors: Design, *Water quality, *Bioindicators, *Coliforms.
Identifiers: *Bacteriological sampling, *Calculations.

Operating characteristics provide a basis for rational design of water quality surveillance programs. In this paper operating characteristic curves of the USPHS bacteriologic quality standards are derived for both the membrane filter method and the most probable number method. These curves indicate the probability that water of a certain coliform bacteria density will be acceptable. The importance of volume and number of monthly samples in determining the risks of unknowingly accepting waters having high coliform densities is discussed. Under present USPHS standards, the probability of rejecting water having a coliform density of 1 per 100 ml. is relatively constant and less than 0.01 for all membrane filter method and most probable number method day-to-day samples. It is suggested that greatly improved drinking water quality control be obtained by examining a minimum of 8 monthly 200-ml. samples by the membrane filter method for continuous surveillance. Operating characteristic curves are shown for monthly control periods for both the membrane filter method and the most probable number method.
W69-01812

COLIFORM AFTERGROWTHS IN CHLORINATED STORM OVERFLOWS,
R. Eliassen.
ASCE Proc, J Sanit Eng Div, Vol 94, No SA2, paper 5913, pp 371-80, April 1968.

Descriptors: *Coliforms, *Storm runoff, *Overflow, *Chlorination, Estuaries.
Identifiers: *Combined sewers, Bacteriological sampling, Dilution.

Laboratory tests were conducted on possible bacteriological effects of combined sewer storm overflows into tidal estuary; overflow mixture was diluted with 3 to 25 volumes of estuarine waters to represent dilutions expected under average storm conditions; bacterial growths were observed in raw overflow and at various dilutions, using 3-liter flasks at 68 F, with incubation periods up to 120 hr; most probable number values of coliforms were determined after fixed time intervals.
W69-01813

THE FLOW IN A STREAM AS A MEASURE OF THE DEGREE OF DILUTION OF STORM-WATER DISCHARGES,
R. Gaul.
Gesundheits-Ing, Vol 73, 404, 1952.

Descriptors: *Storm runoff, Flow measurement, *Waste dilution.
Identifiers: *Combined sewers.

A method is described for calculating the discharge of storm water from combined sewerage systems in relation to the flow of the receiving stream.
W69-01817

RIVER-WATER QUALITY CRITERIA IN RELATION TO WATERWORKS REQUIREMENTS,
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-01825

ANALYSIS OF DISSOLVED OXYGEN DISTRIBUTION IN EAST RIVER,
D. J. O'Connor.
Water Poll Control Fed J, Vol 38, No 11, pp 1813-30, Nov 1966.

Descriptors: *Water quality, *Storm runoff, *Overflow, *Dissolved oxygen, Biochemical oxygen demand.
Identifiers: *Calculations, East River (NY).

Analysis of water quality in East River, New York, by mathematical model consisting of linear differential equations produced results agreeing generally with observation of actual conditions; storm overflows and sludge deposits appear to have significant effects; spatial profile of DO is directly related to wastewater discharges and temporal distribution is established primarily by temperature distribution during summer; future work will require more accurate measurements of sludge deposits, storm overflows, nitrogenous, and carbonaceous BOD components, exchange and dispersion coefficients, and other parameters.
W69-01842

EVALUATION OF DISPERSED POLLUTIONAL LOADS,
G. W. Reid, and J. Cleveland.
ASCE Environ Eng Conf-Preprint 422, Feb 6-9, 1967. 10 p.

Descriptors: *Storm runoff, *Land use, *Water quality, *Runoff.
Identifiers: *Calculations, *Urban drainage, Tulsa (Okla).

Experimental technique proposed is to determine quality of storm water from individual drainage basins that make up urban Tulsa City-County, Oklahoma, and by using component analysis technique, evaluate effects of land use practices on quality of runoff; stream is sampled twice monthly during dry weather flow, and several times during storm runoff period; 'dry' streams are sampled just during runoff period; it is estimated that at least 1 or possibly 2 yr of data will be needed to make representative estimation of true quality and quantity of runoff; principal components of many variables will be estimated by component analysis technique; knowing principal component regression analysis can be used to determine best model and predictive equation.
W69-01848

5B. Sources of Pollution

GROUNDWATER CONTAMINATION AND HYDROCHEMICAL FACIES OF SHALLOW AQUIFERS IN MASSACHUSETTS,
Massachusetts Univ., Amherst, Dep of Geology.
For primary bibliographic entry see Field 02K.
For abstract, see .
W69-01639

ATMOSPHERIC CONTRIBUTIONS TO WATER QUALITY OF STREAMS IN THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE,
U. S. Geological Survey and Sears, Roebuck and Co., Chicago, Illinois, and Dartmouth College, Hanover, New Hampshire.
For primary bibliographic entry see Field 02A.
For abstract, see .

/69-01644

IIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT,
Vashington State Univ., Pullman.
ames W. Crosby, III, Donald L. Johnstone, and harles H. Drake.
Vater Resources Res, Vol 4, No 5, pp 1095-1114, ct 1968. 20 p, 17 fig, 1 tab, 17 ref.

escriptors: *Path of pollutants, *Groundwater, Soil disposal fields, *Sands, *Gravels, Glacial rift, Model studies, Washington.
lentifiers: Spokane Valley (Washington).

he movement of pollutants in glacial outwash in e Spokane Valley, Washington, was studied by rilling test holes in a hospital's waste disposal stem drainfield and further checked by con-ructing a sandbox model of a stratified sand and avel deposit. Dry deposits were found, by study drilling samples and nuclear well logs, at depths 20-40 ft below the drain field. Most of the water the drain field and the model is dispersed terally in the finest beds by capillary movement nd probably returns to the atmosphere by apotranspiration. The moisture conditions in the ain field and local climate data suggest that charge by precipitation is very unlikely in the udy area. Chemical pollutants were observed to ove with moisture fronts, but particulate matter, cluding bacteria, did not travel more than a few (Knapp-USGS)
/69-01645

NTERCEPTOR SEWERS,
or primary bibliographic entry see Field 08A.
or abstract, see .
/69-01728

URVEY OF NAJAFGARH DRAIN OWNSTREAM OF INDUSTRIAL AREA,
R. Bulusu, and V. P. Sharma.
nvir Health, India, Vol 8, pp 103-111, 1966. 3 b.

escriptors: *Storm runoff, Discharge (Water), Dissolved oxygen, *Biochemical oxygen demand, ater quality, Standards, *Rainfall intensity, Water pollution.
entifiers: *Suspended solids, *Combined sewers, mna River (India).

uring the period March-July 1962, the Najafgarh ain, which carries a mixture of industrial waste ater and sullage besides storm water, and the retch of the Jumna River into which it discharges, ere surveyed 11 times from 12 stations. Graphs d tables are given showing quantitative data on tal and suspended solids, dissolved and absorbed ygen, BOD, chlorides and sulphates. The quality the river water at a station near the point of scharge was judged to be satisfactory in relation the requirements of the Indian Standards Institu-on and it is concluded that, during the summer, e quality of the water is suitable for use at a wnstream water works and by riparian owners, t that heavy rains will cause excess pollution as a sult of bottom scouring.
69-01729

EWER INFILTRATION.
or primary bibliographic entry see Field 08G.
or abstract, see .
69-01735

FFECTS OF INFILTRATION,
ivid P. Backmeyer.
ater Pollut Control Fed J, Vol 32, No 5, pp 539-0, May 1960.

escriptors: *Pumping, *Corrosion, *Sewers.
entifiers: *Sewer infiltration, Florida.

The problems of infiltration of both fresh and salt water in the sewage collection and treatment plants in Florida are briefly discussed. Because of the flatness of the land many more pumping stations are necessary in Florida cities than is usual. This magnifies the overflow problem. Problems include corrosion of treatment facilities by salt and other chemicals in sea water.
W69-01736

DETECTION AND SEALING OF LEAKS IN SEWERS,
B. W. Brunton.
Can Mun Utilities, Vol 101, No 12, pp 22-3, Dec 1963.

Descriptors: *Sewers, *Sealants, Equipment.
Identifiers: *Sewer infiltration.

New chemical grouting method tried in Sudbury, Ont., to repair gaps between joints in sewer system and prevent infiltration consists of TV camera and rejointer apparatus attached to cable drawn through sewer lines, when leak joint is noticed, rejointer is drawn to edge of pipe joint, then drawn required distance to have it centered at joint which is then confined and calked by remote control using chemical grouting material; rejointer consists of hollow aluminum cylinder slightly smaller in diameter than pipe, encased in rubber jacket which is strapped to cylinder at ends and at center.
W69-01738

PIPE JOINTS LIMIT INFILTRATION,
For primary bibliographic entry see Field 08G.
For abstract, see .
W69-01739

THE INFILTRATION PROBLEM IN SEWAGE COLLECTION SYSTEMS,
Arthur A. DeFraites.
Southwest Water Works J, Vol 44, No 10, Jan 1963.

Descriptors: *Sewers.
Identifiers: *Sewer infiltration.

The author discusses the sewage infiltration problem and gives his views on how near he believes it is to being solved.
W69-01740

EXFILTRATION TESTING OF LARGE SEWERS IN KANSAS CITY, MO.,
J. F. Fladung, and L. W. Weller.
Water and Wastes Eng, Vol 4, No 9, pp 87-9, Sept 1967 and No 10, pp 60-63, Oct 1967.

Descriptors: Sewers, Manholes, Water pollution control.
Identifiers: *Sewer infiltration, *Leak detection, *Kansas City (Mo).

Test results discussed are for sewers constructed of reinforced concrete pipe, with manholes included in test sections; exfiltration specification used permits leakage of 200 gal/in. of ID/mi/24 hr; data are presented on several contracts under Kansas City's pollution abatement program; exfiltration test conditions and results are summarized.
W69-01741

AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM DESIGN,
J. C. Geyer, and J. J. Lentz.
J Water Poll Control Fed, Vol 38, No 7, p 1138, July 1966.

Descriptors: *Sewers, *Design, *Storm runoff, Construction, *Groundwater.
Identifiers: *Sewer infiltration, *Residential sewers.

A study of sewer systems in four communities revealed that flow of domestic wastewater follows indoor water use and undergoes little seasonal change. Per-capita use increases with the economic status of the area. Flows of stormwater and groundwater infiltration often exceed domestic flows considerably where poor sewer construction and illicit connection to the system are prevalent. Stoppages are caused chiefly by roots and accumulated deposits, the latter especially at the upper ends of systems. Bitumastic joints are most resistant to root penetration; newer materials have not been evaluated. Other causes of stoppages are slug discharges of grease and mud from construction.
W69-01742

ELIMINATING INFILTRATION OF GROUND WATER INTO SEWERS,
J. Godbehere.
Survr, London, Vol 121, 1962.

Descriptors: *Flow measurement, Sewers, *Sealants, *Groundwater.
Identifiers: *Sewer infiltration.

The author summarizes events which led to the application of Terraseal for controlling infiltration of ground water into sewers in the rural district of Amersham, Bucks. As a result of infiltration the cost of disposing of sewage, which is discharged to the West Herts Main Drainage Authority, became disproportionate to the population served. A method of assessing flow, used in river gauging, was used to determine volume of infiltration between sampling points. Initial measures to control infiltration were unsatisfactory, but a new chemical grouting process using Terraseal has resulted in a high degree of success. Terraseal is a form of sodium alginate capable of forming viscous solutions and of being converted to a stable jelly; addition of a suitable inhibitor to the solution during preparation prevents micro-organisms from attacking the jelly. The method of application is described.
W69-01743

'SMOKING OUT' ILLEGAL HOUSE DRAINS,
A. Larmon.
Wastes Eng, Vol 34, No 11, p 603, Nov 1963.

Descriptors: Sewers, Manholes, Equipment.
Identifiers: *Residential sewers, *Downspouts.

Smoke testing equipment consisting of portable 1500 cfm Homelite blower connected by canvas air-duct to sheet of 3/4-in. plywood lined with sponge rubber to fit over manhole was used to locate downspouts connected to sanitary sewer system in South Charleston, W Va; smoke was applied in manhobe by lighting smoke bomb on suction side of blower and discharging it through manhole into sewer.
W69-01745

INFILTRATION AND SEWER FOUNDATIONS,
For primary bibliographic entry see Field 08G.
For abstract, see .
W69-01746

INFILTRATION AND SEWER FOUNDATIONS,
Tulane Univ., New Orleans, La.
John K. Mayer, F. W. MacDonald, and S. E. Steimle.
Public Works, pp 105-107, Dec, 1967.

Descriptors: *Sewers, *Construction.
Identifiers: *Sewer infiltration, *Gulf Coast.

A study on the most suitable foundation materials and best types of sewer arrangements to decrease and control infiltration in the Gulf Coast area was carried out. Various foundation materials and arrangements under various laying conditions were tested in laboratory and field studies to determine the most suitable bedding in a number of soil types common to the area. This report covers methods of

investigation and work completed in the laboratory in silty sand and fat clay with clam shell bedding.
W69-01747

REMOTE CONTROL GROUTING OF SEWER LINE LEAKS,
James Metz.
Water Wastes Eng, Vol 5, No 6, p 68, June 1968.

Descriptors: *Sewers, *Sealants, *Equipment.
Identifiers: *Sewer infiltration.

A procedure for repairing leaks in sewer lines, known as telegrout, involving the use of remote control grouting, is described. Equipment required in the process includes a van-type truck, chemical grout mixing and pumping equipment, sewer grouting packers and plugs, air compressor, television inspection components, winches, downhole sheaves, and communication system. A winch cable, to which is attached a television camera and sewer grouting packer, is pulled through the sewer line. The trailing winch line is attached to the grouting packer, and a communication line is placed between the two winches and the grouting engineer. The inline equipment is then moved through the sewer line. When a leak is observed on the television monitor, the grouting packer is set over the leak and sufficient chemical grout is pumped through the set packer to seal the leak. The grout requires 5 to 15 minutes to set. The television inspection system may also be used for survey work to determine the condition of lines before starting a repair program. Pictures can be made from the monitor screen for permanent records of lines being surveyed or repaired.
W69-01748

LABORATORY INVESTIGATION OF SOIL INFILTRATION THROUGH PIPE JOINTS,
E. H. Nettles, and N. B. Schomaker.
Nat Res Council-Highway Res Bd-Res Rec, No 203, pp 37-56, 1967.

Descriptors: *Pipes, *Model studies.
Identifiers: *Sewer infiltration.

Investigation of infiltration characteristics of four soils--poorly graded medium to fine sand, uniformly graded fine sand, silt, and lean clay, to develop system of classifying soils according to degree that infiltration through pipe-joint openings may be expected to occur; investigation included design and construction of model simulating prototype pipe joint, study of feasibility of using model for such studies, investigation of variables affecting soil infiltration, and investigation of infiltration of soils described.
W69-01749

SEAL SEWER LEAKS FROM INSIDE,
For primary bibliographic entry see Field 08G.
For abstract, see .
W69-01750

PING-PONG BALLS WILL TRACE POLLUTION.

Sewage Works Eng, Vol 19, p 450, Sept 1948.

Descriptors: Water pollution, *Tracers, *Sewers.
Identifiers: *Storm sewers.

Champaign-Urbana, Ill., is faced with a storm sewer problem which has apparently resulted in pollution of an area referred to as the Boneyard. The lack of funds in the budgets of the two cities had delayed a survey of the storm sewer system, but a study of sections of the sewers will be started immediately. The work will be carried out under the direction of Walter M. Kunsch, engineer-manager of the Urbana-Champaign Sanitary District. The check will be made of dropping ping-pong balls or other floating matter down toilets in the area drained by certain sections of the doubtful storm sewer system. If the balls turn up at the Boneyard, outlet for the storm sewer system, rather than at the sewage treatment plant of the Sanitary District, it will be evident that sanitary sewage is cross-connected to the storm sewers. The homes from which the ping-pong balls were discharged will be traced and the pollution corrected.
W69-01762

REPORT ON POLLUTION FROM OVERFLOWS - THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO.

Black and Veatch, Conslt Engrs, Kansas City, Mo., 1962.

Descriptors: *Overflow, Water pollution, Biochemical oxygen demand, Sewage treatment, *Storm runoff, Surface runoff.
Identifiers: *Interceptor sewers, Sewer separation.

Engineering studies of the Chicago Interceptor Sewer System - including identification of system sections which limit capacity, frequency of overflows, and pollution loads (P. E.) - showed an enormous B. O. D. contribution (75%) from the sewage treatment plants in relation to the overall pollution of the waterway. Construction of additional treatment plants nearer to the source of sewage load, tertiary treatment facilities, and ultimately, complete separation of sanitary sewage from storm water, are suggested. Areas requiring further study include the feasibility of stormwater treatment facilities, the pollutional character of surface runoff and the entire industrial waste problem.
W69-01790

PRELIMINARY POLLUTION STUDY UPPER EAST RIVER.

Report to New York City and New York State Depts of Health. Lockwood, Kessler and Bartlett, Inc., (No Date).

Descriptors: *Water pollution, Sewage effluent, Sewage treatment, *Overflow, Tracers, *Chlorination, *Storm runoff.
Identifiers: *Combined sewers, *Storage tanks, New York (N. Y.).

Basic analysis of origin of pollution in upper East River indicates that these stem from discharge of unchlorinated effluents of 4 major sewage treatment plants and overflows from 80 combined sewers. Hydrographic studies detailing float studies, dye trails and tidal observations indicate travel of pollution in area. Recommendations for further studies to determine the frequency-quantity relationship of rainy weather overflow of raw sewage and to investigate the effect of Ch and/or storage on rainy weather overflows from combined studies are made.
W69-01791

INVESTIGATION OF POLLUTION OF EASTCHESTER BAY.
Bureau of Sanitary Engineering, New York City Department of Health.

Descriptors: *Overflow, *Water pollution.
Identifiers: *Combined sewers, *Bacteriological sampling.

Data presented emphasizes that overflow from combined sewers is a major contributor to pollution in area. Bacteriological sampling data is tabulated.
W69-01793

ACTIVITIES REPORT, JULY 1, 1964 - JUNE 30, 1965, BASIC AND APPLIED SCIENCES BRANCH, DIVISION OF WATER SUPPLY AND POLLUTION CONTROL.
U. S. Public Health Serv.
1965, 58 pp.

Descriptors: *Water pollution control, *Surface runoff, Sewage effluent, *Chemical analysis, Bacteriological sampling, Waste dilution.
Identifiers: *Urban drainage.

This report reviews research carried out from 1964 to 1965 by the Basic and Applied Sciences Branch of the Division of Water Supply and Pollution Control, aimed at determining causes and methods of control of water pollution. Work has included studies on the chemical and microbiological analysis of wastes; the polluting effects of urban and rural run-off; the persistence of organic chemicals in surface waters and their amenability to biological degradation; the effects of pollution on aquatic life and on municipal water use; methods of waste treatment, including advanced treatment of sewage; and control of surface-water quality by dilution and by removal of nutrients from effluents. A list of papers published during the year is appended.
W69-01794

THE DAY-TO-DAY POLLUTION PROBLEMS OF THE THAMES ESTUARY,
L. C. Betts.
J Proc Inst Sew Purif, Pt 1, pp 48-63, 1964.

Descriptors: *Estuaries, *Storm runoff, Discharge (Water), *Water pollution control, Legislation.
Identifiers: *Thames estuary.

The author outlines some of the sources of pollution of the Thames estuary and their effects, including shipping, stormwater discharges, used cooling water, sewage-works effluent, trade effluents, and miscellaneous sources, and indicates some of the measures being taken to reduce pollution, including legislation and the work of the Port of London Authority.
W69-01797

OBSERVATIONS ON THE RECOVERY OF A BRITISH RIVER FROM GROSS ORGANIC POLLUTION,
R. O. Brinkhurst.
Hydrobiologia, Vol 25, pp 9-51, 1965.

Descriptors: Sampling, Water pollution control, Overflow, *Storm runoff, *Bioindicators.
Identifiers: Derbyshire (Great Britain).

Until 1957 the lower reaches of the river Derwent, Derbyshire, were heavily polluted with effluent from Derby sewage works and from an industrial plant and with heated cooling water from the latter and from a power plant; in 1957, a new sewage works was put in operation to treat both sewage and the industrial waste water and cooling towers and recirculation systems were installed to control the heated discharges. Since then, several biological surveys of the river above and below the sewage works have been carried out; results are tabulated and discussed. Immediately after the removal of the gross pollution there was a dramatic recovery in the condition of the river, but this was followed by a period of fluctuating conditions and there is now a uniformly poor fauna of tolerant species at all stations in spite of the chemical evidence that the river is cleaner above the sewage works than below it; it is concluded that no further improvement can be expected until upstream sources of pollution (mostly small sewage works and storm-sewage overflows) are improved and the flushing of polluted tributaries is prevented. Particular attention has been paid to the Oligochacta in the river, and the results confirm that these organisms, when identified to species and estimated quantitatively, can be useful in assessing pollution.
W69-01799

THE DETERGENT CONTENT OF RIVER WATER AS A FUNCTION OF WATER FLOW,
W. Bucksteeg, and N. Wolter.
Water Res, Vol 1, pp 325-333, 1967.

escriptors: *Storm runoff, Outlets, *Detergents, Vater pollution, *Waste dilution.

he content of detergent in river water is lowered s the water flow increases because of the dilution, ut the total amount of detergents, or the load, ses. This increase is caused by the discharge of ewage without biological treatment through ormwater outlets and by the reduction of the re-ntion-time in the river during the high flow. Both ctors diminish the possibility of biological decay, that the relationship between water flow and de-rgent load is a result of more or less complete odegradation. It is influenced by the temperature nd degradability of the detergents. The introduc-on of soft detergents since October 1964 has aused an important decrease in detergents at low nd medium water flows. The advantage of soft de-rgents is therefore masked by the growth of de-rgent use in recent years.
769-01800

HEMICAL AND PHYSICAL COMPARISON F COMBINED AND SEPARATE SEWER ISCHARGES,
J. Burm, D. F. Krawczyk, and G. L. Harlow.
Water Poll Control Fed, Vol 40, No 1, p 112, Jan 968.

escriptors: Discharge (Water), *Biological ox-gen demand, Sewers.
dentifiers: *Combined sewers, *Storm sewers, Suspended solids, Ann Arbor (Mich), Detroit Mich).

comparative study of separate storm-sewer scharges in Ann Arbor, Mich., with combined scharges in Detroit showed that the BOD in the parate discharges was about 20 percent of that in e combined discharges. Concentrations lessened discharge progressed. Values for total and olatile suspended solids and for total and volatile tteable solids were higher in the separate system ecause of greater erosion in hillier terrain. hosphates were higher in combined flows, but trates were lower. Higher concentrations also ere found in the combined system for phenols, H3-N, and organic N. In the separate system, OD was fairly constant throughout the year, but the combined system summer BOD's were gher. Both systems showed lower phosphate con-ntrations in autumn.
769-01801

ACTERIOLOGICAL COMPARISON ETWEEN COMBINED AND SEPARATE EWER DISCHARGES,
J. Burm, and R. D. Vaughan.
Water Poll Control Fed, Vol 38, No 3, p 400, arch 1966.

escriptors: Discharge (Water), Sewers, Coliforms, *Runoff.
dentifiers: *Combined sewers, *Storm sewers.

omparison of discharges from combined and parate sewer systems in two Michigan cities owed that total coliform concentrations in runoff rried by separate storm systems are about one nth of those in combined sewers. Fecal coliform nsities in combined systems are about 20 percent total coliform densities, but are usually a lesser rcentage in separate systems. Fecal streptococ-s densities in combined systems are only about ice those in separate systems. Ratios of fecal liforms to fecal streptocci for the systems in-cate that fecal coliforms in separate sewer scharges are primarily of non-human origin, and ose in combined sewer discharges are of human igin.
69-01802

OURCE AND PERSISTENCE OF NEMATODES SURFACE WATERS,
Chaudhuri, R. Siddiqi, and R. S. Engelbrecht.
Amer Water Works Assoc, Vol 56, pp 73-88, Jan 64.

Descriptors: *Subsurface drainage, *Surface runoff, *Sewage effluent, *Bioindicators, Sampling, Water pollution.
Identifiers: *Bacteriological sampling, *Urban drainage.

The importance of collecting large volumes of water to composite nature to obtain representative samples is stressed. The 5 mu membrane filters yield a complete recovery of nematodes. Subsurface drainage, surface runoff, and waste treatment effluent are the 3 main sources of nematodes in surface waters, but only the waste effluent carries high concentrations of nematodes. Urban drainage has a higher nematode content than that of rural area. The nematode load of a stream receiving rural drainage appears to be related to the flushing capacity of the runoff and of the stream and to the carrying capacity of the stream. The persistence of nematodes in streams appears to be related to the mean stream temperature, the stream temperature changes, the rate of flow of the stream, and the nature of the nematode population. The pattern of seasonal variation in nematode populations in streams appears to be the same regardless of the source of nematodes.
W69-01805

FOCUS ON POLLUTION REDUCTION IN SCOTLAND,
R. W. Covill.
Survr, Vol 130, No 3938, pp 25-6, Nov 25, 1967.

Descriptors: *Water pollution control, *Surface runoff, Drainage, Estuaries.
Identifiers: *Scotland.

Industrial and population growth increased number and density of water discharge points along rivers, locks and estuaries, and similarly volume and strength of such discharges have increased; industrial effluents include organic, inorganic, radioactive, and pollution resulting from heated effluents; land drainage comprises silt pollution, surplus irrigation water, surface water runoff and agricultural particles and fertilizers; responsibility for water resources management should be vested in one organization covering functions of potable and industrial water supply, drainage, and municipal and industrial water treatment and pollution prevention.
W69-01806

FIELD STUDIES ON THE FLOW AND COMPOSITION OF STORM SEWAGE,
R. N. Davidson, and A. L. H. Gameson.
Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers (Gt Brit).

Descriptors: *Overflow, *Storm runoff, *Sampling, *Biochemical oxygen demand, *Water pollution.
Identifiers: *Suspended solids.

Investigations on sewers draining three areas, one in Northampton, one in Bradford, and one in Brighouse resulted in data from which several graphs and equations were derived and used to estimate the effect of changes in overflow setting on the frequency duration and volume of discharge from a hypothetical overflow. The overflows at Brighouse and Bradford did not conform to such ideal conditions. Calculations indicated that the flow at which first spill should occur might vary by over 3%. These particular overflows are discussed and the various ways of expressing overflow settings are summarized. An automatic sampler was used at each site for storm sewage. There was a tendency for the strength of sewage to decrease with time during a storm. Variations in average composition of storm sewage with ratio of excess flow to total flow are given. Tables are included of the average maximum values of suspended solids and BOD, the multiples of daily dry weather load discharges from hypothetical overflow at Northampton, and existing overflows at Bradford and Brighouse in a year of average rainfall.
W69-01807

BACTERIAL SURVEY OF STREAMS AND BATHING BEACHES AT CLEVELAND,
J. S. Delos.
Sewage and Industrial Wastes, Vol 22, No 12, pp 1618-24, Dec 1950.

Descriptors: *Water pollution, *Recreation facilities, *Storm runoff, *Overflow, *Coliforms, Bioindicators.
Identifiers: Bacteriological sampling, Cleveland (Ohio).

This article is a condensation of the original report submitted to the Commissioner of Sewage Disposal and covers the 1949 survey and a comparison with earlier pre-war studies. The objects of the 1949 survey were: (1) To determine the present level of pollution of the bathing beaches as compared to prewar level. (2) To determine the effect of storm water overflows on the pollution level. (3) To determine the quality of water flowing in the streams discharging into the lake. Brief description of testing, areas tested and short tables of data are included. Conclusions reached were that coliform count definitely increased during wet period. For a given period, the number of days of rain has a greater effect than the amount of rain which fell at a particular period.
W69-01808

POLLUTION PREVENTION IN NORTHERN IRELAND,
T. R. Graham.
Effluent Water Treatment J, Vol 7, No 1, pp 35-37, Jan 1967.

Descriptors: *Water pollution, *Storm runoff, *Overflow, Rainfall intensity.
Identifiers: *Combined sewers, *Storage tanks, Northern Ireland.

A general report on current water quality conditions in Northern Ireland at a time of intense expansion involving the growth of cities, creation of a city, construction of a motorway network, and the doubling of ferry capacity between Britain and Northern Ireland is presented. The need for future legislation that will prevent and control pollution from industrial and agricultural effluents is stressed. Where there are combined sewers, high rainfall in some areas causes much direct pollution from storm sewage and prevents adequate retention time of storm water at the works. New development areas have separate sewage systems. In a few areas storm-water is settled by tanks at the overflow, with occasional desludging.
W69-01818

SOURCES AND CONTROL OF RIVER POLLUTION,
R. D. Hoak.
Instruments, Vol 25, No 12, pp 1714-6, Dec 1952.

Descriptors: *Storm runoff, *Water pollution, Water pollution control, *Instrumentation.
Identifiers: *Urban drainage.

Five principal sources are erosion, storm water runoff from urban areas, domestic sewage, industrial waste and acid mine waters; varieties of pollution which result from these causes; extent of stream self purification; pollution control and types of instruments applicable.
W69-01822

PATHS OF POLLUTION IN NEW YORK HARBOR-MODEL STUDY,
W. T. Ingram, and H. Mitwally.
Water Poll Control Fed J, Vol 38, No 10, pp 1563-81, Oct 1966.

Descriptors: *Path of pollutants, *Model studies, *Water pollution, *Storm runoff, Overflow, Estuaries.
Identifiers: New York (N Y).

Extensive study utilized dye releases in model of New York Harbor to trace paths followed by pollutants discharged at particular points; influences of installed jetties and dikes on pollution paths and relationship between release concentrations at source of pollution developed by individual tests and those shown by simultaneous release from multiple sources were investigated; pollution sources were wastewater treatment plants and stormwater overflows; this type of study is useful in predicting effects on pollution paths of changes in harbor configuration and waste discharge before such changes actually are made in prototype.
W69-01828

THE POLLUTION OF RUN-OFF FROM URBAN HOUSING ESTATES,
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-01831

SEWAGE LOAD OF RECEIVING STREAMS FROM MIXED SEWERS,
H. H. Mueller.
Gas-Wasserfach, Vol 109, No 6, pp 143-147, 1968.

Descriptors: *Water pollution, Sewage treatment, *Storm runoff, *Overflow.
Identifiers: *Calculations, *Storage tanks, *Capacity, *Combined sewers.

Investigations into the determination of the amount of impurities which are annually introduced, under specific combinations of control measures, into receiving streams are described. Fundamental theories and assumptions are presented, followed by the corresponding calculations. The balance of impurities shows that the introduction of rainwater settling tanks into the treatment considerably increases the efficiency which also depends on the chosen critical rainfall and the size of the tanks. The (1+4)Q sub s infeed to the sewage plant results in favorable efficiency only for small critical rainfalls and small tanks. Larger tanks are best used when the (1+1)Q sub s infeed to the plant is observed. In size determinations, consideration should preferably be given to a critical rainfall of 10 to 15 l/s.ha. Rainwater hold-up time in the settling tanks should be at least 10 minutes. However, if it is possible to install a large collecting main with a high threshold for the rainwater overflow, an equivalent effect would be obtained with a hold-up time of about 3 minutes for the maximum infeed.
W69-01840

MERRIMACK RIVER POLLUTION ABATEMENT STUDY,
P. W. Prendiville.
Boston Soc Civ Engrs, Vol 51, pp 316-328, 1964.

Descriptors: *Storm runoff, *Overflow, *Water pollution control, Sewage treatment, Sewage lagoons, Estuaries.
Identifiers: Merrimac River (Mass).

In view of the increasing pollution of the Merrimack River, which is formed in New Hampshire by the confluence of the Pemigewasset and Winnipesaukee Rivers and flows through Massachusetts to the Atlantic Ocean, surveys have been carried out to determine the present condition of the river and the degree of treatment required for sewage and trade waste waters discharged to it. The results of the investigations on the extent of organic and bacterial pollution and the polluting effects of overflows of mixed sewage and storm water are discussed briefly. Various alternative plans for sewage treatment have been considered, and it was recommended that the individual communities and metropolitan regions should be responsible for constructing the necessary sewage-treatment facilities; these would include extended-aeration plants, primary treatment plants, and sewage lagoons. An industrial survey showed that all the trade waste waters in the area can be treated in the municipal plants, after preliminary treatment at the source in some cases.
W69-01846

POLLUTION STUDY OF A FUTURE TIDAL ESTUARY,
C. A. Rambow.
J Water Poll Control Fed, Vol 36, pp 520-528, 1964.

Descriptors: *Estuaries, Surface runoff, *Flood control, *Dissolved oxygen, *Path of pollutants, Outlets, *Biochemical oxygen demand.
Identifiers: *Los Angeles (Calif).

Dominguez channel is a natural watercourse carrying surface run-off and waste discharges from an area south-west of Los Angeles into the east basin of Los Angeles Harbour. During heavy rainstorms, flooding occurs, and the lower portion of the channel is now being improved to control this. The design is such that the invert will be below mean sea level for a distance upstream of more than 8 miles, and the finished channel will therefore constitute a tidal estuary. At present, the waste waters discharged to the channel are too strong for biochemical action to occur, but when diluted with a large volume of sea water it is possible that biochemical degradation will occur in the channel, with depletion of dissolved oxygen and formation of odours. Theoretical analysis was, therefore, used to estimate the waste-assimilating capacity of the improved channel; this involved calculation of the spread of pollutants from the various outfalls, estimation of the oxygen resources of the channel, and comparison of oxygen demand with oxygen resources to determine the most critical point of the channel. By equating B.O.D. to oxygen supply at this point, an oxygen sag curve for the channel was obtained for the calculated B.O.D. loadings; this curve can be used as the basis for siting future outfalls and for determining the allowable discharge of B.O.D. by various industries.
W69-01847

THE PERMISSIBLE DILUTION AT STORM WATER OUTLETS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01853

PUBLIC HEALTH - WATER SUPPLY.

Mass Ann Laws ch 111, secs 159-175 (1967).

Descriptors: *Massachusetts, Legislation, Administration, *Administrative agencies, Water policy, Water pollution control, Water pollution sources, *Water quality, Water requirements, Permits, Pollution abatement, *Regulation.

The department of public health is given general supervision over all inland water sources used by cities, towns, public institutions, etc. A permit from the department is required before anyone may make a cross connection between a water distribution system for domestic water and one for water not approved by the department. The department may, upon petition and after public hearing order the abatement of pollution. Appeals are provided for, and either the supreme judicial or the superior court is to enforce the orders of the department. Agents of the department may enter any premises to find whether sources of pollution exist there, or to see if the department's orders are being followed. Several rivers are exempted from these provisions. No polluting matter may be discharged into any body of water which is a water source for domestic uses, but prescriptive and legislatively granted rights are not to be affected by this provision. Pollution may be enjoined by either the supreme judicial or the superior court. A penalty is set for willful defilement of a water source or conductor, and for bathing in a source of water for domestic use. Arrests without warrant are authorized for such violations. Driving animals across ice to be cut for domestic purposes is forbidden. Special provisions are made to protect the Charles River from pollution. (Williams-Fla)
W69-01938

WEST KY COAL CO V RUDD (ACTION BY FARM OWNER AGAINST 8 COAL MINING CO'S TO ENJOIN DISCHARGE OF COAL WASTES).
328 S W 2d 156-161 (Ct App Ky 1959).

Descriptors: *Kentucky, Judicial decisions, Farms, *Coal mine wastes, *Rivers, *Overflow, Damages, Water pollution, Sewage, Prescriptive rights, Drainage, Mining, Minewater, Acid mine water, Mine acids.
Identifiers: Injunction, Equity.

An action was brought by a farm owner against coal mining companies to enjoin the discharge of coal slack, copperas waters, and other deleterious substances into the waters of a river from which they were deposited on his farm during overflow periods, causing damage to productivity and fertility. The farm owner also sought damages. The trial court granted the injunction and ordered the damages issue transferred to a common law docket for a jury trial. The appelate court held that when a court of equity had taken jurisdiction, the plaintiff was properly not required to elect which company he would seek damages against, although the companies were not joint tortfeasors. The statute requiring water to be drained as directly as practicable to adjacent streams or watercourses from mines was designed only to require that the water be kept out of working places for safety purposes. It could not be construed as direction or permission to pollute waters, but if the statute could be so construed, it would have been impliedly repealed by the pollution statutes. (Watson-Fla)
W69-01957

ROLE OF SILT IN WATER POLLUTION,
For primary bibliographic entry see Field 02J.
For abstract, see .
W69-01968

NORTH DADE WATER CO V ADKEN LAND CO (INJUNCTIVE RELIEF FROM DRAINING OF EFFLUENTS INTO PRIVATE LAKES).

114 So 2d 347-348 (3d D C A Fla 1959).

Descriptors: *Florida, Judicial decisions, *Effluents, *Drainage effects, Public health, Sewage bacteria, *Water pollution, Sewage effluent, Water pollution sources.

A temporary injunction was granted by the trial court, enjoining the North Dade Water Company from draining effluent into two land locked lakes located on appellee's property. Appellant discharged effluent into Myrtle Lake, which is joined with appellee's lakes by a culvert which was recently installed. Appellee presented evidence showing sewage in both of his lakes and attesting to a strong odor in the area of Myrtle Lake. The appellate court upheld the decision, stating that the judge must have considered possible future pollution and its effect on the health and welfare of the surrounding property owners. (Sisserson-Fla)
W69-01948

5C. Effects of Pollution

COMPARISON OF THE DISTRIBUTION OF ORGANIC MATTER IN THE FIVE GREAT LAKES,
Michigan Univ., Ann Arbor, Great Lakes Research Div., Inst. of Science and Tech.
Andrew Robertson, and Charles F. Powers.
Part of final rept. of USPHS Grant WP-00311 Michigan Univ Spec No 30 of the Great Lakes Res Div pp 1-18, 1967. 18 p, 7 tab, 3 fig, 22 ref. ONR 104-818.

Descriptors: *Eutrophication, *Great Lakes, Nutrients, Plankton, Zooplankton, Productivity, Surface waters, Water quality, Dissolved solids, Organic matter, Biological properties.
Identifiers: *Particulate organic matter, Macrobenthos.

Particulate and dissolved organic matter were measured in all 5 of the Great Lakes and the biomass of zooplankton and macrobenthos were measured in the upper 3 lakes. In general, total organic matter increases in the order, Superior, Huron, Michigan, Erie, Ontario, the same order as shown by total dissolved solids and total dissolved organic matter. This may also represent their relative states of eutrophication. Dissolved organic matter content in the surface waters is 2.22-2.98 mg/l in Lake Superior, 2.52-2.91 mg/l in Lake Huron, 3.24-5.81 mg/l in Lake Michigan, 5.82-6.01 mg/l in Lake Erie, and 5.85-6.53 mg/l in Lake Ontario. The particulate organic matter is much greater than the amounts of zooplankton and macrobenthos. (K-napp-USGS)
W69-01620

PESTICIDE OCCURRENCE, CONCENTRATION AND DEGRADATION IN FREE WATER SYSTEMS,
Massachusetts Univ., Amherst.
C. W. Miller, B. M. Zuckerman, and H. B. Gunner.

Mass Univ, Water Resources Res Center, Symp Proc, Publication No 3, pp 94-99, June 2, 1967. 6), 5 tab, 5 ref.

Descriptors: *Pesticide kinetics, *Pesticide esidues, *Degradation (Decomposition), *Translocation, Cranberries, Diazinon, Dieldrin, Fish, Mussels, Fresh Water, Irrigation.
Identifiers: *Pesticide concentration, Parathion, Cranberry bogs.

The degradation and movement of pesticides used n cranberry bogs were studied to relate application ractices to pesticide pollution. Dieldrin is usually pplied in granular form once every 4-5 yr. Soil amples 12 in. deep were collected from areas with ast histories of dieldrim applications. Analyses inicated that very little vertical leaching occurs even fter 10 yr, probably because of high organic conent of the soil. None has been observed in solution n drainage water. The effect of flooding on movement of diazinon and parathion was studied by ooding a greenhouse model of a cranberry bog on hich the chemical had been applied at field rates. bout 4.6% of the diazinon and 6.5% of the arathion were present in the flood waters. arathion concentration decreased from 0.07 ppm o 0.002 ppm and diazinon decreased from 0.32 pm to 0.01 ppm, in 144 hours. It is recommended at no bogs be flooded for at least 72 hr following esticide application, and that when water flows rough a bog, less hazardous chemicals be used. (Knapp-USGS)
W69-01634

DSORPTION OF PESTICIDES ON EARTH ATERIALS,
assachusetts Univ., Amherst, Dep of Plant and oil Sciences.
H. Baker, and Oh Young Shin.
ass Univ, Water Resources Res Center, Symp oc, Publication No 3, pp 75-88, June 2, 1967. 14 5 fig, 7 tab, 7 ref.

escriptors: *Pesticide kinetics, *Adsorption, arth materials, Soils, Clays, Soil water, Diazinon, rbicides, Organic matter, Leaching.
entifiers: Atrazine, Stream sediments.

eliminary experiments were performed to deterne the effects of time, salt concentration, and ncentration of atrazine and diazinon on the adrption of atrazine and diazinon, which are comnly used pesticides, on soils. Equilibrium was atned within 6 hr. Atrazine adsorption was connt over the range of salt concentration to be excted in soil water, but increased greatly at a conntration of 0.5 moles per liter. The amount of azine absorbed is a linear function of atrazine ncentration. The only soil property that seemed be related to atrazine adsorption was organic ntent. The adsorption of atrazine on pure clay nerals was studied and the results are presented tables. Diazinon was more strongly adsorbed than atrazine, and its adsorption is more affected by organic content. Tabulated data include the effect of time of reaction on atrazine adsorption, the effect of calcium chloride on atrazine adsorption, distribution coefficients for atrazine adsorption on 21 soils, linear regression coefficients relating atrazine adsorption to organic content, distribution coefficients for diazinon adsorption on 16 soils, and hydrolysis of diazinon in the presence of montmorillonite. (Knapp-USGS)
W69-01635

STUDIES OF MILWAUKEE HARBOR AND EMBAYMENT,
Michigan Univ., Ann Arbor, Great Lakes Res Div, Inst of Science and Tech.
John C. Ayers, and Joseph C. K. Huang.
Michigan Univ Spec Rep No 30 of the Great Lakes Res Div, pp 372-394, 1967. 22 p, 9 fig, 2 ref.

Descriptors: *Water pollution effects, *Lake Michigan, *Eutrophication, Pollutants, Turbidity, Color, Dissolved oxygen, Oligochaetes, Bioindicators, Amphipoda, Bottom sediments, Benthos.
Identifiers: *Water-borne parameters, Milwaukee Harbor.

The quality of water and the biological associations of Milwaukee Harbor water and adjoining Lake Michigan water were studied to learn the mutual effects of the heavily polluted harbor on the lake and of the clean lake on the harbor. Milwaukee harbor is enclosed by a breakwater and heavily polluted by the Milwaukee River and by a sewage outfall just south of the river inside the breakwater. Municipal water intakes are located to the north and south of the harbor entrance and obtain good quality water. The distribution of oligochaetes, sphaeriids, and amphipods, as well as of transparency sulfides, and dissolved solids indicate that Milqaukee harbor is functioning as a sewage lagoon in which settlement and mineralization take place. Currents move generally northward in the area from September through March and southward from April through August. Polluted water from the harbor seldom reaches the intakes to the city water system, and on the few occasions it does it is much diluted by lake water and somewhat purified by its residence in the harbor. (Knapp-USGS)
W69-01649

THE INTERNAL DISTRIBUTION OF ANALYSIS VALUES AS AN INDICATOR OF EUTROPHICATION,
Michigan Univ., Ann Arbor, Great Lakes Res Div, Inst of Science and Tech.
John C. Ayers.
Michigan Univ Spec Rep No 30 of the Great Lakes Res Div, pp 395-411, 1967. 17 p, 7 fig, 4 tab, 7 ref.

Descriptors: *Eutrophication, *Indicators, *Lake Michigan, *Statistical methods, Frequency analysis, Dissolved solids, Nitrogen, Phosphorus, Seston, Sulfates, Conductivity.
Identifiers: Skewness, Kurtosis.

The skewness and kurtosis of frequency curves of chemical analysis data of Lake Michigan water and sediments were used to show subtle changes in the early stages of eutrophication. The data analyzed are concentrations of orthophosphate, sulfate, seston ash, total dissolved solids, total phosphorus, nitrogen by Kjeldahl analysis, and conductivity. Definite differences in skewness and kurtosis were found in the distribution of the analyzed concentrations between sampling lines across the industrialized and eutrophying southern end of the lake and sampling lines farther north. The northern data were more skewed and peaked in phosphorus, sulfate, conductivity, and seston ash. The southern lines were more skewed and peaked in nitrogen ashfree dissolved solids, and total dissolved solids. (Knapp-USGS)
W69-01650

PERMISSIBLE WATER POLLUTION AT COMBINED SEWER OVERFLOWS,
G. Akerlindh.
Sewage Works J, Vol 21, No 6, p 1059, 1949.

Descriptors: *Overflow, *Water pollution, Dissolved oxygen, Coliforms.
Identifiers: *Combined sewers.

By plotting the hours duration of storm-water overflow against allowable D.O. content and coliform density in the stream, on double log diagrams, the author presents a method for estimating the permissible storm water overflow in a receiving body of water.
W69-01681

THE BACTERIOLOGICAL EFFECT OF COMBINED SEWER OVERFLOWS ON THE DETROIT RIVER,
R. J. Burm.
J Water Poll Control Fed, Vol 39, No 3, p 410, March 1967.

Descriptors: *Overflow, Discharge (Water), *Coliforms, *Water quality, *Rainfall intensity.
Identifiers: *Combined sewers, Detroit (Mich).

A study of water quality at various points in the Detroit River before and after rainfalls causing overflows of combined sewers showed that, in at least this case, effects of these overflows persist for several days after discharge has ceased, with duration of effects increasing with increase in the intensity of the storm. Bacterial densities may increase a thousandfold after moderate rains at sampling points, within several miles downstream from combined sewer outfalls. Farther downstream, increases in bacterial densities are less, but occur over greater portions of the stream width. Fecal coliforms and fecal streptococci follow patterns similar to those of total coliforms.
W69-01730

POLLUTIONAL EFFECTS OF STORMWATER AND OVERFLOWS FROM COMBINED SEWER SYSTEMS.

Public Health Service Pub No 1246, 1964.

Descriptors: *Storm runoff, *Overflow, *Water pollution control, Sewage treatment, Sewers, Water pollution, *Control, Cities.
Identifiers: *Combined sewers.

The purpose of this report is to examine and assess in a preliminary way existing data on stormwater and combined sewer overflows in regards to characteristics and pollutional effects, and to investigate existing and possible corrective measures for dealing with the problem. The sources of data include more than 50 engineering reports and completed questionnaires regarding sewer systems and/or sewage treatment, reports of detailed studies of water quality data and stormwater separations, and interviews with municipal sanitation representatives. These sources provide information on (a) quantity and quality of combined sewer overflows; (b) effects on streams, water uses, and users; (c) adverse effects, and if any, existing or suggested control measures and their effectiveness; and (d) costs necessary for control.
W69-01795

SELF-PURIFICATION IN MUSSELS FROM THE MEDITERRANEAN-ITS USEFULNESS - ITS ACCOMPLISHMENT-RESULTS OBTAINED,
R. Buttiaux, and R. Ferrand.
Symp Comm Int Explor Scient Mer Medit, Monaco, 1964, pp 299-306, 1965.

Descriptors: *Water pollution, *Storm runoff, Outlets, *Overflow, *Pathogenic bacteria, Standards, *Shellfish.
Identifiers: *Bacteriological sampling, Toulon (France), Interceptor sewers.

Mussels cultivated in Lazaret bay, Toulon, France, are subjected to much pollution and have in the past caused serious typhoid epidemics. The bay, which is almost completely enclosed, being connected with the open sea by only two narrow passages, receives waste waters from the dockyard and from warships anchored in the harbour; polluting material is also carried into the bay by run-off, during the heavy storms which are frequent in this region; and although an intercepting sewer, with an outfall outside the bay, has been built to divert a large part of the municipal sewage, the storm-sewage overflows still discharge into the bay itself, and the water and mussels still suffer faecal contamination, as shown by tabulated data. Although bacteriological examination of water in the bay before and after a period of 5 hours' sunshine showed an important reduction in the numbers of Escherichieae, the bactericida action of sea water is slow, especially in the case of Salmonella, and it is too slow to prevent the penetration of salmonellae into molluscs. A plant was therefore set up at Toulon for the self-purification of shellfish in clean sea water and the bacteriological quality of mussels was assessed before and after treatment, on the basis of standards proposed for the content of Escherichia coli and Streptococcus D. Good results were achieved as regards the protection of public health, with no loss in the organoleptic quality of the shellfish.
W69-01803

STORM-WATER INVESTIGATIONS AT NORTHAMPTON,
A. L. H. Gameson, and R. N. Davidson.
J Inst Sew Purif, Pt 2, 1963.

Descriptors: *Flow measurement, *Biochemical oxygen demand, *Storm runoff, Water pollution, *Overflow, Sewage effluent, Sewage treatment.
Identifiers: *Suspended solids, *Storage tanks, *Capacity.

Tabulated and graphical results are given of studies carried out at Northampton over a period of 2 years on the flow and composition of sewage in a main sewer, with no overflows, particularly during wet weather. It was found that the strength of the storm sewage entering the system, as judged by the B.O.D., was less at high flows, decreased with time since the start of the storm, and increased with length of time since the previous storm. The storm sewage contained a higher concentration of suspended solids than did crude sewage, the greatest concentration of solids being associated with the first flush of storm sewage and this maximum value was greatest when the storm had been preceded by several days of dry weather. The polluting effect of the first flush of storm sewage is attributed to the scouring out of grit and organic solids deposited in the system during dry weather. It was estimated that, had the system been provided with a storm-water overflow, raising the setting of the overflow by one times dry-weather flow would have roughly the same proportional effect throughout the range from 3 to 30 times dry-weather flow, and no substantial reduction in the amount of polluting matter discharged would be achieved by a small change in the setting. However, the provision of storage capacity equivalent to 2-hour dry-weather flow at the overflow would reduce the B.O.D. load discharged from an overflow set at 6 times dry-weather flow by about 40 per cent, and trebling the storage capacity would reduce the load by a further 20 per cent of the initial value, equivalent to raising the overflow setting to 11 times dry-weather flow. The average B.O.D. load discharged per year from an overflow set at 6 times dry-weather flow would be nearly as great as the B.O.D. load discharged as sewage-works effluent during the same period if the whole flow to treatment were discharged as effluent with B.O.D. of 20 ppm and the suspended solids discharged would be equivalent to 3 times the load in a sewage effluent containing 30 ppm solids. It is stressed that the results of this investigation cannot be applied to other sewerage systems until comparable data are available for other sites.
W69-01816

THE RETENTION OF POLLUTING MATTER FROM STORM OVERFLOWS,
H. Guntzel.
Gesundheits-Ing, Vol 56, 1933.

Descriptors: *Storm runoff, *Water pollution, *Overflow, Weirs, Design.
Identifiers: *Suspended solids.

Discusses the effect on streams of polluting matter carried by storm water from sewer overflows, conditions of flow at overflow weirs, different methods of retaining solid matter (screens, settling tanks, baffles, etc.) and their advantages, disadvantages and possible improvement. A design of overflow is suggested in which the overflow water passes through screens inclined at such an angle that the screening can be returned by an automatic scraper. The installation of a screening plant permits the discharge of greater quantities of storm water into a stream as the dilution necessary is less for screened than for unscreened storm water. The economics of storm water treatment are discussed.
W69-01819

EFFECT OF STORM OVERFLOWS ON RIVER QUALITY,
W. F. Lester.
Symp on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Water quality, *Overflow, *Storm runoff, Discharge (Water), *Water pollution.
Identifiers: *Storage tanks.

It is assumed that the 'standard' storm sewage overflow in excess of 6 d.w.f. flows to a river which has a rate of flow of 1, 10, and 100 times d.w.f. of the sewage. It is shown that the quality change with increase in rate of flow will depend on the initial quality of the stream. A table indicates the quality of river water below storm overflows. Because the discharges contain more carbohydrates and higher organic compounds than fully treated effluent there is a greater tendency to form fungal growths below overflows. The discharge of E. coli. content increases. The concentrations of toxic materials may be critical from sewers containing industrial wastes. Where rivers are used for direct abstraction of water for potable supplies, overflows cause rapid changes in quality. Fractured sewers can also cause pollution of rivers. The discharges from 'standard' storm tanks will have as much as 80% reduction in pollutional effects on rivers. Brief reports are made on surveys of the River Trent and Tame to determine the effect of storm discharges on these two rivers.
W69-01833

PROBLEMS IN THE CALCULATION OF STORM WATER OVERFLOWS,
W. Losse.
Gas Wasserfach, Vol 29, pp 84-5, 1958.

Descriptors: *Storm runoff, *Overflow, Water pollution, *Rainfall intensity, Design.

The author discusses, from personal experience and from the literature, the amounts of rainfall for which storm water overflows should be designed in order to avoid pollution of the receiving stream. Amounts between 6-10 liters/sec./ha are suggested, varying according to the stream, the slope of the land, and the condition of the sewerage system. The figures must be tested by careful investigation. Calculation of storm water overflows according to amounts of rainfall is preferable to calculation by a mixing ratio which may give a false impression of the load of the stream.
W69-01834

THE STORM-SEWAGE POLLUTION PROBLEM,
C. Lumb.
J Proc Inst Sew Purif, 1964, Pt 2, p 168, 1964.

Descriptors: *Storm runoff, *Overflow, *Water pollution, Design, Sewers, Sewage treatment.
Identifiers: *Combined sewers, *Sewer separation, *Storage tanks.

The author discusses the polluting effects of storm-sewage overflows from combined sewerage systems and methods for reducing such pollution, including the installation of separate sewerage systems, the use of overflow settings higher than the conventional 6 times dry-weather flow, improved design of overflows, screening of storm sewage, and provision of storage facilities at overflows to receive the first flush of the discharge and return it later to the foul sewer. Pollution may also be caused by discharges of partially treated storm sewage from storm-sewage tanks at sewage works; this can be reduced by increasing the flows to be given full treatment and by improved design and operation of storm-sewage tanks.
W69-01835

STORM WATER POLLUTION CONTROL,
Gordon E. McCallum, and Leo Weaver.
Interstate Conf on Water Problems, Dayton, Ohio Dec 10, 1965 9 p, 12 ref.

Descriptors: *Storm runoff, *Water pollution Sewage treatment.
Identifiers: *Combined sewers, *Storm sewers *Sewer separation, Storage tanks.

Inadequacies of combined sewage systems are discussed. Pollution by storm water runoff is described. Government grant projects aimed a solving this problem are outlined. The costlines and relative insufficiency of complete separation o storm sewers from sanitary sewers is mentioned and the need for new alternative solutions (e.g holding tanks, treatment) emphasized.
W69-01836

THE POLLUTIONAL EFFECTS OF STORM WATER OVERFLOWS FROM COMBINED SEWERS,
C. L. Palmer.
Sewage and Industrial Wastes, Vol 22, pp 154-65 1950.

Descriptors: *Water pollution, *Storm runoff *Overflow, Rainfall intensity, Water pollution control.
Identifiers: *Combined sewers, Capacity, *Interceptor sewers.

The author discusses the effects of pollution caused by overflowing of storm water from a combine sewer system. The characteristics of low intensit storms in the Detroit area were first studied and th results shown in graphs. It was found that runoff di not occur unless precipitation was greater tha 0.03 in/hr and storm water would not overflow un less precipitation was more than 0.03 in/hr. plus th capacity of the sewers for storm water. It was foun that intercepting sewers are most effective i preventing overflow when they have a capacity o 150% of the sewage flow, and no satisfactor reduction in number of duration of overflows achieved by increasing the capacity to any reasona ble extent. The quality of the overflowing liquid va ries considerably and would be highly pollutin even from a separate system, the cost of which not commensurate with the reduction in pollutio which it would effect. A properly designed com bined sewerage system should be about 99% effe tive in preventing pollution by storm water ove flows.
W69-01843

SEWERAGE SYSTEMS AND RIVER POLLUTION,
J. A. Pickford.
J Royal Soc Health, Vol 87, No 1, pp 36-42, Ja Feb, 1967.

Descriptors: *Water pollution, *Discharg (Water), *Rainfall intensity, *Storm runoff, *Ove flow, Sewers, Water pollution control.
Identifiers: *Combined sewers, *Storm sewer *Sewer separation, *Capacity.

The effect of discharge of combined, separate, or partially separate sewer systems on river pollution is discussed. Factors affecting the quantity of storm sewage are rainfall and run-off, overflow devices, and the storage capacity of sewers. Several overflow devices are discussed. It is suggested that the increase of treatment plant capacity, the provision of larger sewers, and the provision of selective types of overflow are likely to cost much less than the provision of completely separate systems, and that pollution can be more effectively controlled by these methods.
W69-01844

EUTROPHICATION OF ESTUARINE AREAS BY RAIN WATER,
R. J. Reimold, and F. C. Daiber.
Chesapeake Sci, Vol 8, pp 132-133, 1967.

Descriptors: *Chemical analysis, Rain, Storm runoff, *Estuaries, *Eutrophication, Water quality.
Identifiers: *Atlantic Coast (United States).

Tabulated and graphical results are given of analyses of total phosphorus in rain water at Lewes, Del., from February 1966 to January 1967; the mean concentrations, per litre, were 4.9 microgram-atom in winter and spring, 150 microgram-atom in summer, and 8.1 microgram-atom in autumn and winter. Possible causes of the sudden increase after April are discussed, and it is suggested that this is the reason for the unusual phosphorus cycles found in bay waters and marshes along the east coast of U.S.A., providing an extra source of nutrient during spring and summer when productivity tends to be higher.
W69-01849

HOW COMBINED SEWERS AFFECT WATER POLLUTION. PT 1,
Harold Romer, and Lester Klashman.
Pub Works, Vol 94, p 100, March 1963.

Descriptors: *Water pollution, Sewage treatment, *Design, Discharge (Water).
Identifiers: *Combined sewers, *Urban drainage, Capacity.

This article on studies of pollution of combined sewers discusses results of a questionnaire survey of 148 cities, 80 of which replied (50,000-2,100,000 population). The 11 questions deal with characteristics of combined sewage, combined sewer and treatment plant capacities and design, combined sewage treatment practices, and effects of combined sewage discharges on quality of receiving waters.
W69-01850

HOW COMBINED SEWERS AFFECT WATER POLLUTION. PT 2,
Harold Romer, and Lester M. Klashman.
Pub Works, Vol 94, p 88, April 1963.

Descriptors: *Water pollution.
Identifiers: *Combined sewers, *United States, *Great Britain.

This concluding report on the pollution problems created by combined sewer discharges to waterways during overload periods, cites results of specific studies in the United States and England.
W69-01851

THE INFLUENCE OF COMBINED SEWERS ON POLLUTION CONTROL,
H. Romer, and L. M. Klashman.
Pub Works, Vol 92, No 10, p 129, 1961.

Descriptors: *Water pollution, *Overflow, Design, Surface runoff, *Storm runoff.
Identifiers: *Combined sewers, *Suspended solids, *United States, *Great Britain, *Storage tanks.

In discussing the polluting effects of overflows from combined sewers, the authors review American and British practice concerning the use of storm-water tanks and summarize British recommendations for the design and operation of combined sewerage systems. Data are given to illustrate the effect of storms on the concentration of supsended solids in storm-water sewage, and the results of studies on quality of surface run-off are reviewed. The use of storm-water tanks in America is being reconsidered.
W69-01852

ENVIRONMENTAL EFFECTS OF HIGHWAYS,
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-01854

YEATES V MILLSAPS (OIL POLLUTION).

110 So 2d 369-372 (Miss 1959).

Descriptors: Remedies, Metal pipes, Pipelines, *Damages, Burning, *Mississippi, Cattle, Judicial decisions, *Oily water, Legal aspects, *Water pollution, Pollutants, Oil.
Identifiers: Res ipsa loquitur, Punitive damages.

Plaintiff sued for damages to his land and cattle resulting from a break in defendant's oil pipeline. Defendant had constructed a pipeline near plaintiff's land in 1954. In 1957 a break occurred in the pipeline, allowing oil to spill into a stream which meandered across plaintiff's land. In an effort to remedy the situation, defendant attempted to burn off the oil, thereby damaging the land. In addition, several of plaintiff's cows were killed or injured as a result of drinking oily water. The lower court applied the doctrine of res ipsa loquitur and submitted the issue of punitive damages to the jury with regard to defendant's efforts to burn the oil. Plaintiff recovered $7500. This court held that the res ipsa loquitur doctrine was applicable, and whether defendant had overcome the presumption of negligence was a jury question. The judgment was reversed and remanded, however, since the issue of punitive damages was unwarranted and the court was unable to say that the verdict rendered represented only actual damages. (Kahle-Fla)
W69-01946

AMERICAN CYANAMID CO. V SPARTO (INDUSTRIAL POLLUTION).

267 F 2d 425 (5th Cir 1959).

Descriptors: *Texas, Judicial decisions, Easements, Water rights, Competing uses, *Irrigation water, Riparian waters, Water pollution, Agricultural watersheds, *Industrial wastes, Reasonable use, Chemical wastes, Inorganic compounds, Sodium sulfate, Ammonium compounds, *Riparian rights.

Plaintiffs' land is bounded by a river which is used to irrigate their truck farm. Defendant's upstream chemical plant empties large quantities of process water into the stream. The plaintiffs recovered damages for injury to their crops and land on the grounds of nuisance and negligence for the wrongful pollution of the river by the defendants. It is not a defense that part of the water diverted by plaintiffs was used for non-riparian land because only a lower riparian owner can assert this. An easement along the river granted by plaintiffs to a water control and improvement district, which stated that plaintiffs expected to continue to use the land for farming, did not divest them of such rights and possession to the land as to sever and deprive the rest of the land of its riparian character. (Molica-Fla)
W69-01962

NUISANCES: MANUFACTURING PLANT NOT A NUISANCE AFTER OPERATING FOR ONE YEAR; DAMAGES ON ACCOUNT OF POLLUTION OR OVERFLOW OF STREAM.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01967

THE BIOTIC RELATIONSHIPS WITHIN WATER BLOOMS,
Wisconsin Univ., Madison. Hydraulic and Sanitary Lab.
George P. Fitzgerald.
D F Jackson, Algae and Man, Plenum Press, New York, pp 300-306, 1964. 7 p, 41 ref.

Descriptors: *Eutrophication, Succession, Water quality, Algal control, Algicides, Dominant organisms, Grazing, Water pollution effects, Diatoms, Chlorophyta, Cyanophyta, Nuisance algae, Wisconsin, Nutrients, Indicator species, Euglena, Chlamydomonas.
Identifiers: *Blooms, *Biotic factors, Species diversity, Lake Waubesa, Lyngbya, Microcystis, Aphanizomenon, Anabaena, Melosira, Ceratium, Oscillatoria, Eudorina.

Algal successions, in which nearly unispecific populations of algae alternate with more highly diversified assemblages of species, are characteristic of more natural aquatic environments as well of impoundments, such as sewage stabilization ponds, with no lack of the usually considered nutrients. The usual sequence of species, especially in eutrophic environments, consists of a vernal bloom of diatoms, an early summer growth of green algae, and a late summer bloom of cyanophytes (blue-green algae). After treatment of a water bloom with algicides to alleviate nuisance conditions, the rapid replacement of dominant algal species by others emphasizes that factors which influence dominance may be very subtle. High pollutional loads from sewage sources not only increase algal growth, but may also influence species composition and algal succession. Evidence suggests that secondary effluents may act to suppress succession and reinforce a reduction in species diversity longer than would normally be expected. Since nutrient status of an aquatic environment does not always explain the composition of a bloom, one must often consider the effects of biotic factors such as grazing by the fauna, activities of bacteria and fungi, and the excretion of biologically active compounds by the algae themselves. (Wis)
W69-01977

AN INTRODUCTION TO THE IDENTIFICATION OF CHIRONOMID LARVAE,
Federal Water Pollution Control Admin., Div of Pollution Surveillance, Cincinnati, Ohio.
William T. Mason, Jr.
Processed Rept Mar 1968.

Descriptors: *Midges, *Systematics, Indicator organisms, Macroinvertebrates, Water pollution effects.
Identifiers: Keys, Photographs, Chironomidae, Head capsule.

Author presents a taxonomic discussion of common species of chironomid larvae, organisms of importance as indicators of polluted water conditions. Taxonomic keys are included for five subfamilies and for 55 common genera and sub-genera of the family, Chironomidae (midges). The report incorporates photomicrographs which illustrate important systematic characteristics of the following subfamilies: Tanypodinae, Podonominae, Chironominae, Diamesinae and Orthocladinae; and for the following genera: Tanypus (2 spp), Ablabesmyia, Procladius, Anatopynia, Coelotanypus, Chironomus, C (Einfeldia), C (Kiefferulus), C (Dicrotendipes) (2 spp), C (Cryptochironomus) (4 spp), C (Endochironomus), C (Tribelos), C (Xenochironomus) (2 spp), Goeldichironomus, Glyptotendipes (2 spp), Pseudochironomus, Polypedilum, Paralauterborniella (2 spp), Stenochironomus (3 spp), Stictochironomus, Microtendipes, Tanytarsus, Zavrelia, Micropsectra, Diamesa (2 spp), Prodiamesa (2 spp), Orthocladius (2 spp), Trichocladius, Nanocladius (2 spp), Smittia, Brillia (2 spp), Cardiocladius, Psectrocladius (3 spp), Metriocnemus (2 spp), Diplocladius, Cricotopus (2 spp), and Corynoneura. (Wis)
W69-01978

5D. Waste Treatment Processes

FLUSHING OF SEWER NETWORKS: AUTOMATIC DISCHARGE DEVICE,
For primary bibliographic entry sec Field 08C.
For abstract, see .
W69-01676

AUTOMATIC CONTROL OF PUMPING INSTALLATIONS,
For primary bibliographic entry see Field 08C.
For abstract, see .
W69-01680

SKIPTON-SILSDEN SEWERAGE FINISHED AHEAD OF SCHEDULE.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01684

NEWTHORPE, NOTTS., SEWAGE DISPOSAL WORKS.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01685

RELIEVING OVERLOAD ON TAMWORTH SEWAGE WORKS.

Survr Munic Cty Engr, Vol 129, No 3905, p 59, 1967.

Descriptors: *Overflow, Storm runoff, Irrigation, Sewage lagoons.

At Tamworth, Staffs., as in interim measure until new works are constructed, effluents from the filters and sedimentation tanks, as well as storm-sewage overflows, are collected in a 150,000-gal lagoon and distributed on to 44 acres of grassland by spray irrigation. The irrigated area is divided into 3 plots, and an 8-week resting period is allowed for each plot.
W69-01686

PVC SEA OUTFALL IN HUNSTANTON SEWAGE SCHEME.
For primary bibliographic entry see Field 08C.
For abstract, see .
W69-01687

NEW SEWAGE WORKS COMMISSIONED AT LEICESTER.
For primary bibliographic entry see Field 08C.
For abstract, see .
W69-01688

CHICAGO STUDIES PLAN FOR CONTROLLING COMBINED SEWER OVERFLOWS.
Water and Sewage Works, Vol 113, pp 235-36, July 1966.

Descriptors: *Overflows, *Combined sewer, Storm runoff, Treatment.
Identifiers: Storage tanks, Chicago (Ill.).

A plan is outlined to temporarily store storm water from overloaded and overflowing combined sewers in subterranean chambers and to later treat the polluted water before its discharge into waterways.
W69-01689

METHOD OF AND MEANS FOR DEALING WITH STORM-WATER OVERFLOWS IN SEWERS AND LIKE DRAINAGE SYSTEMS.
Longwood Engineering Co., Ltd.

Brit Patent 1,023,311.

Descriptors: *Storm runoff, *Overflow, *Sewers, *Drainage systems, Outlets.
Identifiers: *Suspended solids.

The equipment claimed for dealing with storm-sewage overflows in sewerage and other drainage systems comprises a bay fitted with a trough or channel which has walls of unequal height and a mouth covered with a filter screen which can be cleaned by a rake or rakes rotating in the direction of flow of water through the bay. Under normal conditions of flow, water passes through the bay direct to the foul sewer, but under storm conditions the increased flow causes a build-up of pressure in the bay so that water and floating trash flows over the lower wall of the trough and through the screen to the storm-sewage outlet; trash is swept from the screen by the rake (s) over the higher wall into a trash pit and thence to the foul sewer.
W69-01690

TECHNICAL COMMITTEE ON STORM OVERFLOWS AND THE DISPOSAL OF STORM SEWAGE.

London, Ministry of Housing and Local Government, 1963. 16 pp.

Descriptors: *Storm runoff, *Overflow, *Discharge (Water), Sewage treatment, Design.
Identifiers: *Suspended solids, *Storage tanks.

In the interim report of the Technical Committee which was set up in May 1955 to study and report on storm overflows and the disposal of storm sewage, present practice in the discharge of storm sewage is reviewed; investigations are reported on storm water in 3 drainage areas, Northampton, Brighouse, and Bradford, on the use and operation of storm tanks at sewage works in Tunbridge Wells and Stoke-on-Trent, and on the characteristics of different types of storm overflow; and preliminary conclusions are drawn, particularly with regard to the volumetric setting of storm overflows, the design of overflows to reduce pollution (by providing storage for the first flush of storm sewage and minimizing the amount of floating and heavy-solid polluting material in the overflowing sewage), and the treatment of storm sewage at the sewage works. It is recommended that each sewerage authority should review existing arrangements for the disposal of storm sewage, and the information required in making this assessment is listed.
W69-01691

OPERATING EXPERIENCES AT SWINDON, 1962 - 1967,
W. F. Carmichael.
Meeting of the Institute of Water Pollution Control, Central Southern Branch, March 27, 1968.

Descriptors: Storms, *Automatic control, Sewage treatment, *Equipment, *Overflow, *Storm runoff.
Identifiers: *Storage tanks, Capacity.

The sewage plant, its equipment, and operation are described. In dry weather, only one screen is used. It is operated by a time-clock for five minutes in every fifteen. In time of storms both screens are operated continuously by hand. There are 2 No. detritors with vortex grit washers. Both detritor scrapers, air lift pumps and vortex washers are operated continuously. Three stormwater overflows are controlled by an automatic penstock and standing wave flume. All overflows discharge into a single circular stormwater tank 200 ft. in diameter and of 2 mil. gal. capacity. Effluent from this tank overflows onto 11 acres of underdrained stormwater land.
W69-01696

RAIN DISCHARGE AND SEWAGE SLUDGE,
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01700

DESIGN, CONSTRUCTION AND OPERATION OF SEWER OUTFALLS IN ESTUARINE AND TIDAL WATERS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01703

MEASUREMENT OF MANNING'S ROUGHNESS COEFFICIENT,
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01709

SOME HYDRAULIC ASPECTS OF SEWERAGE AND SEWAGE DISPOSAL,
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01711

WATER POLLUTION R AND D GRANTS.

Environ Sci Technol, Vol 1, No 3, p 189, March 1967.

Descriptors: *Grants, *Water pollution control, Overflow, *Automatic control, *Flow control, Storm runoff.
Identifiers: *Combined sewers, *Storage tanks, *Sewer-within-sewer.

Approximately $20 million in contracts and grants were awarded in 1966 by the Federal Water Pollution Control Administration. About half the total was for studies of improved methods for dealing with overflows from combined sewers. Nine cities were awarded a total of slightly more than $8 million to help finance such projects as construction of large detention basins to hold combined sewer overflow prior to treatment, and for installation of automated sewer regulator stations designed to provide better control of combined flows. Contracts of $1.6 million were awarded to private companies to study such possibilities as building a sewer within a sewer or constructing submerged containers capable of holding combined sewer waste until it can be pumped back to the treatment plant.
W69-01717

SEWER SEPARATION.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01719

SEWER WITHIN A SEWER.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01720

SEPARATING STORM AND SANITARY SEWERS IN URBAN RENEWAL.

32nd Report by the Committee on Govt Operations, US House of Representatives, House Rept 1648, US Govt Printing Off, Washington, DC, June 23, 1966. 20 p, 2 tab.

Descriptors: *Water pollution, Grants.
Identifiers: *Storm sewers, *Sewer separation, *Combined sewers, Urban drainage.

The need for separating storm and sanitary sewers is discussed, with emphasis on separating such sewers in areas being developed or redeveloped under federal aid. The 1962 Public Health Service Table on number and size of communities served by combined sewer systems is given. A 1964 Public Health Service appraisal of combined sewers is outlined. Demonstration grants to develop measures to control pollution from combined sewers are described. Problems and controversy concerning separation of sewers in the University-Euclid urban renewal project in Cleveland are discussed and other sewer programs are outlined.
W69-01723

DISPOSAL OF MUNICIPAL SEWAGE (WATER POLLUTION CONTROL AND ABATEMENT).

House of Representatives Union Calendar No 90, 89th Cong, 1st Sess, Rep No 204, 1965. 40 pp.

Descriptors: *Water pollution, *Storm runoff, *Overflow.
Identifiers: *Combined sewers.

This is the 12th report of the U.S. Committee on Government Operations and is based on a study made by its Natural Resources and Power Subcommittee to examine whether Government agencies are coping effectively with water pollution problems and to determine possible improvements in techniques for preventing and controlling pollution of rivers and other water resources. The present position and problems of sewage disposal are reviewed in relation to water pollution, including the problems caused by combined sewerage systems and storm-sewage overflows, and recommendations are made for future action by Government departments; comprehensive planning and co-ordination of sewage-treatment facilities for municipal areas; and development of new methods of sewage treatment.
W69-01724

INTERCEPTORS HAVE UNUSUAL DESIGN FEATURES,
W. M. Bailey.
Water and Wastes Eng, Vol 4, No 1, pp 55-7, Jan 1967.

Descriptors: *Design, Sewers, Storm runoff, Sewage treatment.
Identifiers: *Interceptor sewers, *Omaha (Nebr).

Waste collection and treatment installation in Missouri River basin at Omaha, Nebr; project includes 64,700 ft of collecting sewers and plant that gives primary treatment to wastes before discharging them into river; bi-directional sewer operates during low flow periods as gravity sewer flowing in one direction; during time of storm flow, it becomes force main that flows in two directions; another feature is segregated treatment plant that permits low strength and high strength wastes to be treated separately or mixed in any desirable proportion.
W69-01725

MUNICIPAL SEWERAGE.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01731

RESIDENTIAL USE AND MISUSE OF SANITARY SEWERS,
Grant S. Bell.
J Water Poll Control Fed, Vol 35, Jan 1963.

Descriptors: Sewers, Cities, *Construction, *Qulaity control.
Identifiers: *Residential sewers.

Experience in Kentucky has already proven that it would have been much easier for the cities to have acted firmly on the matter of overloading of sanitary sewers by residence drainage than to suffer the consequences of leaving private sewers to builders' and owners' methods. Quality control of private sewer construction and regulation of the use of sewers are imperative to a totally successful sanitary sewer system.
W69-01737

SEWER DESIGN-INFILTRATION DETECTION AND CORRECTION,
B. J. Haney.
Louisiana State Univ-Eng Res Station-Bul 83, pp 55-71, 1965.

Descriptors: *Sewers, *Design, Pipes, Construction.
Identifiers: *Sewer infiltration, Leak detection.

Calculation of capacity of sewer system, sizing of pipe, determination of pipe slope, selection of pipe material, and proper installation of pipe as basic steps in design of gravity sewer system.
W69-01744

EFFECTS OF USE ON THE HYDRAULIC RESISTANCE OF DRAINAGE CONDUITS,
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01752

PROVIDE DRAINAGE BEFORE FLOODS OCCUR.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01753

PLANNED CITY PLANS TO RE-USE STORM RUNOFF.
For primary bibliographic entry see Field 03C.
For abstract, see .
W69-01759

PROCEEDINGS OF THE THIRTEENTH CONFERENCE OF LOCAL AUTHORITY ENGINEERS, QUEENSLAND, 1962.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01764

THIRTEENTH ANNUAL REPORT, 1963-64.
Mersey River Board.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-01768

MAIN DRAINAGE FOR SKELMERSDALE NEW TOWN,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01784

ELIMINATION OF MARGINAL POLLUTION--JAMAICA BAY.

Report to Dept of Public Works, New York City. Greeley and Hanse, Engineers, (No date).

Descriptors: *Deterioration, *Water quality, *Overflow, Recreation facilities, *Storm runoff, *Water pollution, Sewage treatment, *Chlorination, Sedimentation, *Estuaries.
Identifiers: *Combined sewers, *Storage tanks, *Jamaica Bay (N. Y.).

This report demonstrates the general relationship between deterioration of beach water quality after heavy rains from overflows of mingled sewage and storm water. Recommendations for specific area corrections are detailed - mainly attempting to develop a system of separate sewers to replace existing and overloaded combined sewers. Recommendations would localize potential pollution from storm water overflows to seven areas where storm water overflow treatment works are suggested. Overflow treatment to consist of large holding basins to capture the overflow, permit sedimentation and chlorination prior to ultimate discharge to Jamaica Bay or pumping to sewage treatment plants.
W69-01792

DESIGN CRITERIA FOR INTERCEPTOR SEWERS FOR ST LOUIS,
Erwin E. Bloss.
ASCE Proc, J. Sanit Eng Div, Vol 92, No SA4, Proc Paper 4877, pp 7-31, Aug 1966.

Descriptors: *Design, Pumping, Sewers, *Water pollution control, *Storm runoff, Overflow, *Construction costs.
Identifiers: *Interceptor sewers, *Combined sewers, *Capacity, *St. Louis (Mo).

Preliminary to the sizing of the sewers, pumping stations, and treatment plants of the Metropolitan St. Louis Sewer District's Mississippi River Pollution Abatement Project, it was necessary to adopt a design criterion for the interceptors on the combined sewers. The amount of pollutional load spilled to the river during storm water runoff was computed for interceptors of three different capacities when functioning under rainfall conditions corresponding to those experienced during 1955. Pollution was measured in terms of 'equilvalent hours of sewage flow.' It was found that with interceptors having a capacity of 1.0 times peak sewage flow, 3.1% of the total yearly sewage flow would be spilled during storm water runoff. Furthermore, the efficiency of the overall project after primary treatment would be approximately 0.25% less with interceptor capacity of 1.0 times peak sewage flow than with interceptor capacity of 1.25 times peak sewage flow, whereas the increase in cost of the project, using the larger interceptors would have been on the order of $2,800,000. The smaller size interceptor was adopted.
W69-01798

STORM WATER FLOW SELECTION METHOD ELIMINATES SILT PROBLEM,
G. Chanin.
Water and Sewage Works, Vol 102, No 8, pp 300-3, July 1955.

Descriptors: *Storm runoff, *Storm drains, Sewage treatment.
Identifiers: *Suspended solids.

New Sewage Treatment Plant in Oakland, California, had disadvantage that large volumes of storm water with fine sand and silt reached it so that sludge collectors were completely covered; to eliminate this, channel was constructed to by-pass storm waters; requirements for test to determine whether sand and silt are present and whether by-pass gates should be opened.
W69-01804

POLLUTION CONTROL MEASURES FOR STORMWATERS AND COMBINED SEWER OVERFLOWS,
D. D. Dunbar, and J. G. F. Henry.
J Water Poll Control Fed, Vol 38, No 1, p 9, Jan 1966.

Descriptors: *Water pollution control, *Storm runoff, *Overflow, *Chlorination.
Identifiers: *Combined sewers, *Storm sewers, *Interceptor sewers, Capacity.

Two primary sources of water pollution other than domestic and industrial wastewaters are the discharges from combined sewer overflows and from separate storm sewer systems. Such overflows can contribute objectionable amounts of pollution to receiving waters. Interceptor and wastewater treatment plant capacity in relation to average dry-weather flow shows that the overall efficiency of raw sewage collection is not improved greatly once such capacity reaches 3 x dry-weather flow. Partial separation of stormwater by collecting street runoff in a collection system independent of an existing combined system markedly increases pollution control efficiency of the existing system; this method is about 40 percent as costly as total separation. Volumetric storage sufficient for a storm of 1.2 in/6 hr (30.5 mm/6 hr) can reduce stormwater escaping treatment from 85 to 40 percent. Chlorination of stormwater runoff or of mixtures of stormwater and raw sewage can reduce effectively bacterial concentrations.
W69-01810

KANSAS CITY'S POLLUTION ABATEMENT PROGRAM,
G. J. Hopkins.

Water Pollut Contr Fed J, Vol 39, No 9, pp 1487-1503, Sept 1967.

Descriptors: *Water pollution control, Sewage sludge, Sewage treatment, *Storm runoff, Pumping, *Overflow.
Identifiers: *Combined sewers, Sewer separation, *Kansas City (Mo.), Missouri River.

Kansas City, Mo., is carrying out a $75 million program to abate pollution of the Missouri River and its tributaries in the area. The program is financed by revenue bonds supported by a sewer service charge. The plan is geared to joint use of facilities by Kansas City and the numerous adjacent municipalities. Primary treatment of all wastewater is now in effect. The facilities now completed include four treatment plants and a number of pump stations, force mains, and interceptor sewers. Sewers will be extended to presently undeveloped areas. Unusual features include a sewer river crossing, use of an abandoned water main as a sewer force main, and pumping of sludge 7 miles (11.3km) for treatment at a central facility. Waste treatment is unlikely to provide a total solution to the Missouri River's water quality problems. There is no demonstrable need or economic justification for stormwater separation for the Missouri River. Quality of stormwater overflows may compare favorably with that of the receiving water. These overflows occur less than four percent of the time and their pollutional significance has not been demonstrated.
W69-01823

OIL-SEPARATOR TANKS FOR MOTORWAYS IN THE RUHR VALLEY,
K. R. Imhoff.
Gas Wasserfach, Vol 108, pp 43-45, 1967.

Descriptors: *Highways, *Runoff, *Water pollution, *Storm runoff.
Identifiers: *Storm sewers, Capacity, *Oil pollution.

In connexion with the prevention of pollution by oil, deposited on motorways by the increasing number of oil tankers, and washed-off into the receiving waters by rainfall, detailed studies were carried out by the Ruhrverband on the Westhofer motorway between Remscheid and Kamen. Oil-separator tanks have been installed along sections of the new motorway before the storm sewage enters the receiving water to protect numerous water works in the lower and middle Ruhr, which serve a large community. Based on the specifications DIN 4040 and 4043 of the Ruhrverband, these tanks are constructed for a surface loading of 12 m per hour and a retention period of 10 min; the calculation of the run-off is based on 100 litre per second per hectare. The run-off values and time factor are adjusted to local conditions. Seccessful operational results showed that 6 months after installation a 4-cm deposit of sludge and 1-2m (to the third power) of sand had collected from each influent and these were easily withdrawn by suction pumps. Tabulated data are included and a map shows the areas selected for present and future positions of separator tanks.
W69-01827

NATION'S CAPITAL ENLARGES ITS SEWERAGE SYSTEM,
C. Frank Johnson.
Civ Eng, Vol 28, No 6, 1958.

Descriptors: *Water pollution, *Overflow, Recreational facilities, *Pumping, *Storm runoff.
Identifiers: *Interceptor sewers, *Combined sewers, *Washington, D. C., *Sewer separation.

Pollution from combined sewer overflows is prohibiting the use of Potomac and Anacostia Rivers and Rock Creek in Washington, D.C. for many recreational uses. A $151,000,000 improvement program is recommended, mostly for relief sewers and pumping stations. Some of the interceptors are so inadequate that they overflow even in dry weather. The separation of all sewers was considered but concluded to be too costly. Alternate plan is to construct large enough relief sewers that overflows into Rock Creek will have a dilution factor of 200 and Upper Potomac 30 before overflowing. This represents a storm of 2 year frequency.
W69-01829

CHEMICAL CONTROL OF WATER QUALITY IN A TIDAL BASIN,
M. Lang.
J Water Poll Control Fed, Vol 38, pp 1410-1418, 1966.

Descriptors: *Storm runoff, *Overflow, *Water pollution, Sewage treatment.
Identifiers: *Intercepting sewers, Bergen Basin (N Y).

Bergen basin, a small arm of Jamaica Bay, N.Y., is a tidal basin with no surface-water tributaries, but it receives discharges of storm sewage when the capacity of the nearby Jamaica sewage works is exceeded during storms, and at times in hot weather there has been slight odour nuisance. In 1963, when alterations were being made to the sewage works, all the plant effluent was discharged to the basin for 2 weeks; at this time the influent sewage was septic, having been stored in the intercepting sewers for some months while the alterations were in progress, and this caused severe pollution of the basin with very strong evolution of hydrogen sulphide. In an attempt to improve conditions, bulk sodium nitrate was added to the basin to create aerobic conditions in the bottom deposits and sodium hypochlorite solution was also added to oxidize the hydrogen sulphide in the water; these measures proved effective, and subsequently addition of hypochlorite was discontinued, but sodium nitrate is still being added to the basin.
W69-01832

ADMINISTRATIVE AND FINANCIAL ASPECTS OF OPERATING A METROPOLITAN SEWER DISTRICT,
Metropolitan St Louis Sewer Dist, St Louis, Mo.
P. F. Mattei, and C. B. Kaiser.
Water Pollut Control Fed J, Vol 39, No 4, pp 501-517, April 1967.

Descriptors: Watersheds, *Storm runoff, *Water pollution control, *Construction costs, Outlets, Drainage systems, Sewage treatment.
Identifiers: *Urban drainage, *Interceptor sewers, *St. Louis (Mo).

The organization and financing of the 12 yr. old Metropolitan St. Louis Sewer District are described. A watershed by watershed study was made to determine the stormwater problem and results have shown what the district needs but the more than a hundred million dollar overall cost necessitates a piecemeal approval, dealing with the worst problems through subdistrict programs and self-help programs. To relieve pollution of the Mississippi by sewage, construction of an interceptor sewer picking up all of the wastewater outlets along the river was begun as well as construction of two large primary treatment plants. Problems and possible solutions for financing the needed stormwater facilities are discussed.
W69-01837

THE MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT - OPERATION AND EXPANSION,
K. L. Mick.
Water Pollut Control Fed J, Vol 39, No 10, pp 1684-1700, Oct 1967. 1 fig, 3 tab, 6 ref.

Descriptors: *Sewage treatment, Grants, *Overflow, Construction costs, Water pollution.
Identifiers: *Interceptor sewers, *Storm sewers, *Combined sewers, Minneapolis-St. Paul (Minn).

Results of a 1956-60 study of the Minneapolis-St. Paul Sanitary District called for central treatment of wastewater at the existing plant, plant expansion, and interceptor sewer construction. Estimated costs are given. Expansion of the existing primary plant is discussed. A study on the combined sanitary and storm sewer problem was also included. The study recommended that a system of power-operated gates be installed on 15 key regulators, with gate positions and levels in major sewers telemetered to a central control point. These 15 diversion points accounted for about 80 percent of the overflow to the river in 1960. In 1966 the District received a Federal demonstration grant offer of 50 percent for a sewer regulator project estimated to cost $1,741,500. This work will include an evaluation of the effect on river conditions. A supervisory control system will promote maximum utilization of the interceptor sewer and treatment facilities, taking into account rainfall distribution in the area and other factors. It will provide a new technique of instantaneous observation and control of interceptor system performance to minimize overflows to the river.
W69-01838

DISCHARGE OF RAIN WATER FROM URBAN SEWERS INTO STREAMS,
M. Negulescu, and I. Rabinovici.
Hidrotehnica, Vol 9, pp 205-209, 1964.

Descriptors: *Storm runoff, *Water pollution, Discharge (Water), *Water pollution control.
Identifiers: *Urban drainage, *Combined sewers, *Storage tanks.

It is indicated that rain water discharged from combined or separate sewers in urban areas can have as great or even double the polluting effect of domestic sewage and can damage the receiving stream particularly if the areas are industrial. Storage reservoirs along the sewerage system or as part of the treatment plant are suggested as a means of protecting streams.
W69-01841

THE BATTLE TO SAVE LAKE MICHIGAN,
H. W. Poston.
Civ Eng, Vol 37, No 12, pp 40-43, Dec 1967.

Descriptors: Sewage treatment, *Overflow, *Water pollution control, *Flow measurement, Storm runoff.
Identifiers: *Combined sewers, *Interceptor sewers, *Storage tanks, *Chicago (Ill), *Lake Michigan.

As a result of an enforcement conference called by the Federal Water Pollution Control Administration, Indiana communities whose wastes dump into Lake Michigan have already added secondary treatment facilities; detention facilities and combined sanitary-storm sewers are to be built to prevent overflow. Chicago is attempting to solve this problem by retaining storm water overflows in underground interceptor sewers of large diameter 250 ft. deep, where the water can be stored for future treatment. Milwaukee is establishing automatic monitors along the Milwaukee River to measure the average yearly flows and peak flows of the sewer system as affected by rainfall in an attempt to locate critical points where control facilities should be installed. In addition, a 3.8 million gallon underground detention tank will be constructed to trap storm overflows, which will be retained for subsequent treatment.
W69-01845

STRATFORD-UPON-AVON SEWAGE WORKS.

Wat Poll Control, London, Vol 66, pp 268-269, 1967.

Descriptors: *Storm runoff, Treatment, Land use.

A description is given of the new Milcote sewage works of Stratford, Warwickshire, which provide complete treatment for a dry-weather flow of 1.55

m.g.d. by biological filtration with recirculation of effluent. Sludge is digested and disposed of on land; drying beds are available for dewatering excess sludge. About 1 acre of underdrained land is also available for treatment of storm sewage or for further treatment of final effluent if necessary.
W69-01855

WINDSOR STARTS POLLUTION CLEAN-UP.
Wat Poll Control, Ontario, Vol 104, No 5, pp 23-27, 1966.

Descriptors: *Storm runoff, Sewage effluent, Chlorination.

Treatment facilities provided at the Little River Sewage Works at Riverside, Windsor, Ontario, are outlined and illustrated. The plant, which serves Riverside and Sandwich East, has a capacity of 4 m.g.d., with space available for future expansion; it provides complete treatment by the activated-sludge process. Excess storm sewage and final effluent are chlorinated before discharge to the Little River, while crude primary and excess activated sludge are conditioned with ferric chloride and lime, dewatered on an automatically-controlled vacuum filter, and used as land-fill.
W69-01856

CITY OF MILWAUKEE.
Water Wastes Eng, p 118, (n.d.).

Descriptors: *Overflow, *Storm runoff, *Chlorination.
Identifiers: *Combined sewers, *Storage tanks, Milwaukee (Wis).

Milwaukee is constructing an underground concrete tank to catch rainstorm overflow from the combined sewer system. The demonstration tank will be 170 ft. long, 130 ft. wide and 30 ft. deep and will hold 3,900,000 gal. The tank will be designed to catch the run-off, purify it with chlorine or hold it until the storm ends. Then it will gradually drain the run-off back into the combined sewer system, which flows to the sewage treatment plant.
W69-01857

TREATMENT OF OVERFLOWS FROM COMBINED SEWERAGE SYSTEMS BY USE OF STORM WATER STORAGE AND CHLORINATION.

New Hampshire Water Pollution Commission Staff Report No 40, March 1959.

Descriptors: *Overflow, *Storm runoff, *Chlorination, Water quality, Recreation facilities.
Identifiers: *Combined sewers, *Storage tanks.

A study of a procedure to treat enough of the storm water overflow from an adequate combined system to achieve B-1 quality in a receiving water nearly 100% of the summer bathing season. Assumptions and procedure are detailed.
W69-01858

BACTERIAL REDUCTIONS IN THE CHLORINATION OF SEWAGE--EFFECT OF AGITATION.

New Hampshire Water Pollution Commission Report No 3, Staff Report No 42, March 1960.

Descriptors: *Chlorination, *Sewage effluents, *Coliforms, Sewage treatment.

Report covers three studies on the bacteriologically acceptability of effluents which have been chlorinated with doses of 30 to 40 ppm with gentle stirring after comminution. Study 1: Determined if there exists a practical level of chlorination of raw sewage that 99 percent of time with 15 minute chlorine contact and without settling can be relied upon to produce ultimate coliform bacterial counts in the effluent not to exceed 240/100 ml even when such effluent is subsequently subjected to rigorous breakup of particulate matter. Finding -- At practical chlorine dose levels of 40 ppm or less simple chlorination of unsettled raw sewage cannot be relied upon.
W69-01859

SYSTEM STUDY, DESIGN, AND EVALUATION OF THE LOCAL STORAGE, TREATMENT AND REFUSE OF STORM WATER.
Hittman Associates, Inc.

Final Report - Contract No 14-12-20 with the Federal Water Pollution Control Administration, August 1967, 5 p.

Descriptors: *Storm runoff, *Treatment, *Water reuse, Sampling, Computer programs.
Identifiers: Columbia (Md), *Storage tanks.

An $850,000 two-year program is suggested for the collection of stormwater runoff in three small storage basins and pretreatment units in the new city development of Columbia, Md., the treatment of this runoff to remove pollutants, and its further treatment for potable reuse. A packaged water treatment plant would be used to determine the technical and economic feasibility of such treatment. Gaging and sampling stations, and a connection to the public water system, are included in the plan. A computer-generated cost-benefit analysis was used to determine such facets as optional size of storage reservoirs and optional system configuration. A 'Study of Reuse of Storm Water', by Whitman, Requardt and Associates, indicating various consumptive (e.g., toilet flushing) and non-consumptive (e.g., fire protection) re-uses, forms part of the Appendix.
W69-01860

PROTECTING THE POTOMAC AT WASHINGTON,
D. V. Auld.
J Water Poll Control Fed, Vol 37, pp 275-291, 1965.

Descriptors: *Water pollution control, Water quality, *Chlorination, *Storm runoff, Sewers, Estuaries.
Identifiers: *Combined sewers, *Sewer separation, *Potomac River, *Storage tanks.

To reduce pollution of the Potomac river in the Washington metropolitan area, several counties, cities and towns have formed an informal organization that has adopted water quality objectives for 63 miles of the river, agreed that there should be neither treated nor untreated waste discharges for some 38 miles above the head of tide-water, and established a Regional Sanitary Advisory Board which has developed a comprehensive plan for sewage disposal. As part of this regional effort, the District of Columbia is provided sewerage facilities for much of the surrounding territory, including the new Dulles International Airport in Virginia. The sewage works have been expanded to provide secondary treatment by the highrate activated-sludge process, and it is planned to provide preliminary tanks and chlorination facilities for storm flows in excess of those receiving complete treatment. The new sewerage facilities are on the separate system, and work has already begun on converting the older parts of the system from the combined to the separate type.
W69-01861

CHICAGO MSD PROGRESS REPORT ON CHLORINATION,
Metropolitan Sanitary District of Greater Chicago, Chicago, Ill.
Vinton Bacon.
Water Sewage Works, pp 350-351, Sept. 1967.

Descriptors: *Chlorination, Sewage treatment, *Construction costs.
Identifiers: Capacity, *Chicago (Ill).

It has been possible to complete chlorination facilities for the North Side Sewage Treatment Works 1 1/2 years ahead of schedule, by utilizing the effluent conduit and the North Shore Channel for the contact basins, thus obviating long and costly construction. The cost of this project was a dramatically low $162 per mgd capacity, in contrast to $8,380 per mgd capacity for other plants. At the rated capacity of 300 mdg, a 9-minute detention is achieved in the effluent conduit. Chlorine dosages of 1.8 mg/l are being used for initial operations.
W69-01862

CHICAGO METRO SANITARY DISTRICT MAKES NO LITTLE PLANS,
V. W. Bacon, and F. E. Dalton.
Pub Works, Vol 97, No 11, pp 66-70, 140, 142, 1966.

Descriptors: *Water pollution control, Sewage sludge, *Storm runoff, *Overflow, *Chlorination, Sewage treatment.
Identifiers: *Combined sewers, *Storage tanks, *Chicago (Ill.), Sewer separation, *Rapid filter.

Because of increased demands on treatment plants and higher environmental standards, various solutions are considered for easing the pollution problem in the Chicago area, including the use of long transmission lines to discharge digested sludge to large areas of marginal agricultural soil and to coal strip mines. Also considered is the underground storage of contaminated storm-sewage overflows from combined sewers; storage would be in a system of tunnels and large chambers excavated in solid rock deep under the city, and the sewage would be pumped to the surface for treatment after storms, a more economical solution than the provision of separate sewers. As a temporary solution the District is experimenting with the chlorination of storm-sewage overflows. A brief report is given on the need for tertiary treatment; a 2-m.g.d. plant will be installed as an experiment at the District's Hanover Park plant to provide tertiary treatment by coagulation, chlorination, rapid sand filtration, and final aeration.
W69-01863

THE ST JOSEPH, MISSOURI WATER POLLUTION CONTROL PROGRAM,
R. L. Brown, and W. R. Condon.
J Water Poll Control Fed, Vol 39, pp 1374-1380, 1967.

Descriptors: *Water pollution control, *Storm runoff, *Sewage treatment, Sedimentation, Sewage sludge, Maintenance.
Identifiers: *Combined sewers, St. Joseph (Mo).

To reduce pollution of the Missouri river, a sewage works is being constructed at St. Joseph, Mo., to provide treatment for combined sewage and storm water by aerated grit removal, sedimentation, and sludge digestion. Digested sludge will be dewatered by vacuum filtration, but provision has also been made for dewatering on sand beds or for disposal of liquid sludge on farmland. The operation and maintenance of the sewerage system are described.
W69-01866

CHLORINATION OF MIXED SEWAGE AND STORM WATER,
T. R. Camp.
ASCE Proc, J Sanit Eng Div, Vol 87, No SA 1, 1961.

Descriptors: *Chlorination, *Storm runoff, Outlets, Sewage treatment, *Biochemical oxygen demand, *Pathogenic bacteria.
Identifiers: *Suspended solids, *Combined sewers.

The author deplores the present tendency to concentrate on primary treatment of sewage to reduce the B.O.D. and the concentration of suspended solids, while overlooking the need for destruction of pathogenic bacteria and viruses. In older communities with combined sewerage systems about 3

per cent of the sanitary sewage is discharged with storm water through storm-water outfalls, and this should also receive treatment to remove bacteria. The author describes experiments carried out on the chlorination of sewage alone and in admixture with storm water. The results indicate that such treatment is effective. The amount of chlorine required for disinfection of storm water would be about 50 per cent more than the amount required for treatment of the dry weather flow alone.
W69-01867

STORM-WATER TANKS IN THE COMBINED SEWERAGE SYSTEM OF BERLIN,
A. Cohrs.
Gas Wasserfach, Vol 103, pp 947-952, 1962.

Descriptors: *Storm runoff, *Design, *Construction, Sewage treatment, Cities.
Identifiers: *Storage tanks, Berlin (Germany).

An illustrated description of the design and construction of storm-water tanks in the sewerage system of Berlin.
W69-01869

WEST BRIDGFORD'S 1897 SEWAGE WORKS WILL BE MODERNIZED BY 1964,
R. Dewsberry.
Munic Eng, Vol 139, p 1277, 1962.

Descriptors: Sewage treatment, *Storm runoff, Pumping.
Identifiers: *Storage tanks.

Mining subsidence prevented the building of a new sewage plant for West Bridgford, and it was decided to convey all sewage to the Nottingham treatment plant. The district, which has a population of 3500, has been divided into five new drainage areas. All sewage will be collected at a new main pumping station, and storm-water tanks and an outfall to a watercourse will be provided for high flows.
W69-01870

BIOLOGICAL FILTRATION USING A PLASTIC FILTER MEDIUM,
Water Pollution Research Laboratory, Stevenage, Gt Brit.
G. E. Eden, G. A. Truesdale, and H. T. Mann.
Inst Sewage Purif, J and Proc, Pt 6, pp 562-574, 1966. 3 tab, 7 fig, 7 ref.

Descriptors: *Sewage treatment, Biochemical oxygen demand, Sewage effluent.
Identifiers: *Suspended solids.

Experiments in the use of the Dow 'Surfpac' fabricated plastic medium for use in percolating filters are described. The material was tested in comparison with 2 1/2 in. rounded gravel, and with granite and at various rates of sewage application and BOD loads. It seems clear that effluents of high quality cannot be expected from media of this type; their advantage seems to lie, rather in their ability to accommodate large volumes of film and to permit the rapid passage of suspended matter, as in the treatment of unsettled liquids.
W69-01871

SEWAGE TREATMENT. VII. SEPARATION AND TREATMENT OF STORM WATER,
L. B. Escritt.
Contractor's Rec, Vol 59, No 32, p 11, 1948.

Descriptors: Sewage treatment, *Storm runoff, *Flow control.
Identifiers: *Storage tanks.

Methods of dealing with storm water flow at sewage works with and without storm tanks are described. The design of orifices for control of the flow to the sewage works is discussed.
W69-01872

SEWAGE TREATMENT PROCESSES. IV. STORM TANKS,
L. B. Escritt.
The Water and Waste Treatment J, Vol 6, pp 407-8, Sept-Oct 1957.

Descriptors: *Storm runoff, Pumping, *Flow control, Sewage treatment.
Identifiers: *Storage tanks, *Capacity.

This article deals with the reason for using storm tanks to serve as storage or holding tanks to prevent the discharge of excessive storm infiltration to the treatment works. Points discussed are purpose of storm tanks, theoretical capacity of tanks, storm water separation, storm tank details, and balancing flows from pumping stations.
W69-01873

SEWAGE TREATMENT AT SLOUGH,
John Finch.
Effluent Water Treat J, Vol 4, pp 275-77, June 1964.

Descriptors: *Storm runoff, Sewage treatment.
Identifiers: *Storage tanks.

Sewage treatment works serving the Borough of Slough, next to the lower terraces of the Thames River, are discussed with special emphasis on the design features necessitated by flat topography, high ground water table, and location of the plant site only a few feet above river level. The entire flow is pumped before entry into the plant. The flow is subject to comminution and grit removal. Excessive storm flows are bypassed to storage tanks to be returned to sewage flows when conditions are favorable. Flow is then divided. The high-level plant consists of primary settlement in a circular flow tank, high intensity aeration, effluent treatment by trickling filters, final settling, and disposal to the Thames River. The low-level plant consists of horizontal-flow, rectangular tanks without mechanical sludge removal equipment. Low-level plant flow is divided between standard rate filters and aeration units. When plant modification is complete, the entire flow will be aerated, filtered, and settled. Humus sludge and surplus activated sludge are pumped to primary tanks to be settled out with primary sludge. Sludge is thickened and digested.
W69-01874

COMPLETION OF FURTHER STAGE IN GRANGEMOUTH DRAINAGE SCHEME,
J. M. Fraser.
Consult Engr, Vol 23, pp 550-553, 1963.

Descriptors: *Sewage treatment, Equipment, Discharge (Water).
Identifiers: *Combined sewers.

The new combined sewerage system to serve the Bowhouse area of Grangemouth, Stirlingshire, is described. At the pumping station, flows up to 6 times dry-weather flow are comminuted before discharge to the Forth estuary 270 yards offshore; this volume of sewage will later be treated at a new sewage works which is to be constructed. Flows in excess of 6 times dry-weather flow are screened and discharged to the river Avon.
W69-01875

THE EFFICIENCY OF CONVENTIONAL SEWAGE PURIFICATION WORKS, STABILIZATION PONDS, AND MATURATION PONDS WITH RESPECT TO THE SURVIVAL OF PATHOGENIC BACTERIA AND INDICATOR ORGANISMS,
O. J. Coetzee, and N. Fourie.
Proceedings, Resolutions, and Papers of the Conference on the Problems Associated with the Purification, Discharge and Re-Use of Municipal and Industrial Effluents, Pretoria, 1964, pp 93-108.

Descriptors: Sewage treatment, *Sewage effluent, *Storm runoff, Sewage lagoons, *Bioindicators, *Pathogenic bacteria.
Identifiers: *Bacteriological sampling.

Tabulated and graphical results are presented from studies on the removal of Esch. coli, Salmonella typhi, Pseudomonas aeruginosa, and clostridium perfringens at various stages of the conventional sewage treatment process (using double filtration) and in lagoons. Neither system gave a safe effluent, but the lagoons are considered safer since there were no increases in any species of bacteria at any time. Lagoons have the additional advantage that all crude sewage, even during storms, receives treatment and none is by-passed. Results indicate that Esch. coli is not an infallible indicator for the presence of pathogenic organisms; a new indicator organism is needed and it is considered that an indicator fungus would have certain advantages which are listed.
W69-01876

AUTOMATED PUMPING STATIONS FOR OUR NATION'S CAPITAL,
E. E. Halmos.
Water Sewage Works, Vol 114, No 9, pp 319-321, Sept 1967.

Descriptors: *Automatic control, Sewage treatment, *Storm runoff, Pumping, Sewers.
Identifiers: *Storm sewers, *Interceptor sewers, *Urban drainage, Sewer separation, *Washington, D.C.

Two new installations are described. The Potomac Station is an automated plant which handles sewage and stormwater from the sewage interceptor line serving Dulles Airport and other Virginia and Maryland communities. The 'O' St. Station handles sewage and stormwater from a redevelopment area where 100 acres of slum is being replaced. Both units will eventually bypass the main station which has 4 sanitary pumps operating at near their capacity of 280 mgd; the six stormwater pumps can handle up to 480 mgd. The city has totally separated storm and sanitary sewers. The pumps and the operation procedures of the station are described.
W69-01878

WESTON-SUPER-MARE'S NEW DRAINAGE SCHEME,
J. R. F. Hewish.
J Instn Munic Engrs, Vol 93, pp 30-32, 1966.

Descriptors: *Sewage treatment, Pumping, *Storm runoff.

The new drainage scheme of Weston-super-Mare, Somerset, is described in more detail, with particular reference to the dry-weather-flow and storm water pumps, the system of power supply which involves electric power from the mains, two diesel alternators to reduce the maximal demand from the mains, and an emergency generator, and the system of alarm to warn of the danger of flooding. In continued dry weather the flow to the station is 400,000 ft (3) per day or 57 gal per head per day.
W69-01879

PROVIDING PRIMARY TREATMENT FOR STORM SEWAGE OVERFLOWS,
W. C. Hirn.
Wastes Eng, Vol 33, 1962.

Descriptors: *Storm runoff, *Overflow, *Sewage treatment, Sewage sludge, Sedimentation.
Identifiers: *Interceptor sewers, *Urban drainage, *Combined sewers.

The Milk River Drain project which serves Grosse Pointe Woods and Harper Woods to the northeast of Detroit, Mich., is described. Sewage is discharged to the Grosse Pointe interceptor which discharges to Detroit municipal sewers; combined flows in excess of 8000 gal per min are diverted to a sedimentation-skimming tank to remove sludge before discharge to Lake St. Clair. Settled sludge is periodically flushed from the sedimentation tan

and discharged to the Grosse Pointe interceptor for treatment at the Detroit sewage-treatment plant.
W69-01880

DESIGN AND OPERATING EXPERIENCES AT THE NEW WORSLEY U D C SEWAGE WORKS,
J. M. A. Hope.
J Proc Inst Sew Purif, pp 455-458, 1965.

Descriptors: *Sewage treatment, *Storm runoff, Overflow.

The new sewage works serving Worsley, Walkden, and Little Hulton, Lanes., are designed to treat 1 m.g.d. of mainly domestic sewage by the activated-sludge process with Simplex aeration cones; there are no storm overflows on the sewers near the works and full treatment is provided for flows up to 4 times dry-weather flow and the remainder receives primary treatment. Experiences in the initial operation of the plant are outlined.
W69-01881

EFFECT OF STORAGE AND SKIMMING ON COMBINED SEWAGE OVERFLOWS,
Hubbell, Roth and Clark, Inc., Bloomfield Hills, Mich.
George E. Hubbell.
39th Annual Conference of the Water Pollution Control Federation, Kansas City, Mo, Sept 25-30, 1966, figs, tables.

Descriptors: Drainage systems, *Weirs, Outlets, Flowmeter, Rain gages, Sampling, *Overflow.
Identifiers: *Combined sewers.

The first year's operation of the Twelve Town Drainage District's relief drainage system is reported. A high weir skimming structure at the outlet is described, and flow metering, a rain gage network, and laboratory facilities at the Outlet Structure (including automatic samplers) are noted. Sewage and overflow characteristics are compared, and primary settling is viewed as not likely to produce significant changes.
W69-01882

DESIGNING OF SEWERAGE SYSTEMS,
A. C. Koot.
Water, Vol 51, No 8, pp 165-69, April 20, 1967.

Descriptors: *Design, *Sewers, *Storm runoff, *Overflow.
Identifiers: *Capacity.

The author summarizes the designing of grit chambers, primary and secondary sedimentation tanks, low- and high-rate trickling filters, low- and high-rate activated sludge plants, and digestion tanks. Sufficient storage capacity in or in addition to the sewerage system for storm overflows is also discussed.
W69-01883

SEWERAGE AND SEWAGE DISPOSAL IN RETROSPECT AND PROSPECT,
M. Lovett.
Survr, Vol 104, 587, 1945.

Descriptors: Sewage treatment, *Storm runoff, *Rainfall intensity, *Storms, Design.
Identifiers: *Combined sewers, *Great Britain, Surface permeability.

The development of sewerage systems in Great Britain, and disposal and treatment of storm waters are described. In a particular district the extent of impervious areas, intensity of rainfall, localization of storms, and the nature, size, and use of nearby streams determine whether a combined or a separate sewerage system is more suitable.
W69-01888

CONSTRUCTION AND MAINTENANCE OF SEWERS AND DRAINS.

Mass Ann Laws, ch 83, secs 1-13 (1966).

Descriptors: *Massachusetts, *Administration, *Drains, *Sewers, Legislation, Construction, Maintenance, Repairing, Cities, Administrative agencies, Water pollution, Ditches, Sewerage, Treatment, Facilities, Eminent domain, Obstruction to flow, Sewage disposal, Permits, Government finance, Damages, Administration.

Section 1 authorizes specified municipal officials to lay out such drains and sewers as they deem necessary for public health, and to take land necessary for this purpose by eminent domain. Sections 2 and 3 deal with keeping records of sewer and drain plans, descriptions and repairs, and with sewer connections to houses and buildings. Section 4 provides for construction of ditches and drains for highway drainage, and the taking of land by eminent domain for that purpose. Section 5 requires certain landowners to maintain separate plumbing systems for water and sewage. Sections 6 and 7 deal with the establishment of sewage disposal works and pollution or nuisances caused by them. Sections 8 through 10 set forth regulations regarding sewers and drains. They provide fines as high as $100.00 for excavating public ways for laying or repairing sewers or drains without a permit, obstructing the flow of water in ditches or drains, and obstructing the flow of sewers. Sections 11 and 12 provide fines for refusal to connect with common sewers or to repair private drains. Section 13 vests equity jurisdiction in certain courts to enjoin unlawful use of sewers. (Smodish-Fla)
W69-01926

5F. Water Treatment and Quality Alteration

CHEMICAL EFFECTS OF BOTTOM DEPOSITS ON QUALITY OF IMPOUNDED WATERS,
Massachusetts Univ., Amherst, Dep of Civil Engineering.
Tsuan Hua Feng, and Henry C. Hyde, Jr.
Mass Univ, Water Resources Res Center, Symp Proc, Publication No 3, pp 100-119, June 2, 1967. 20 p, 14 fig, 1 tab, 18 ref.

Descriptors: *Water quality, *Hypolimnion, *Bottom sediments, *Decomposing organic matter, *Laboratory tests, Biochemical oxygen demand, Phosphates, Nitrogen compounds, Dissolved oxygen, Impounded waters.
Identifiers: Biological studies, Biochemical process.

Chemical effects of bottom deposits on water quality in the hypolimnion at 20 deg C were studied in laboratory sediment-water columns. Chemical analyses of both the water and the deposits were made to establish the relationship between the transformations of the chemical constituents in the deposits and the changes of chemical quality of the water. Columns 6 in. in diameter and 4.25 ft high were filled with 4 in. of sediment and 4 ft of tap water and kept in darkness at 20 deg C for 6 mo. The 3 sediment samples were digested sludge from a primary treatment plant, bottom deposits from a pond receiving sewage effluent, and bottom deposits of a river receiving untreated paper mill waste. Chemical analysis data are presented in 1 tab and 14 graphs. BOD decreased in the deposits and remained constant in the water. Nitrogen was concentrated in the top 0.75 in. of the deposits, and nitrate concentration increased to 40-140 ppm in the water columns. Phosphates moved from the deposits into the water. Dissolved oxygen was depleted enough to be harmful to most aquatic life. The most rapid quality depletion was in the first 3 mo. (Knapp-USGS)
W69-01633

5G. Water Quality Control

CHEMICAL EFFECTS OF BOTTOM DEPOSITS ON QUALITY OF IMPOUNDED WATERS,
Massachusetts Univ., Amherst, Dep of Civil Engineering.
For primary bibliographic entry see Field 05F.
For abstract, see .
W69-01633

PESTICIDE OCCURRENCE, CONCENTRATION AND DEGRADATION IN FREE WATER SYSTEMS,
Massachusetts Univ., Amherst.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-01634

ADSORPTION OF PESTICIDES ON EARTH MATERIALS,
Massachusetts Univ., Amherst, Dep of Plant and Soil Sciences.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-01635

ATMOSPHERIC CONTRIBUTIONS TO WATER QUALITY OF STREAMS IN THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE,
U. S. Geological Survey and Sears, Roebuck and Co., Chicago, Illinois, and Dartmouth College, Hanover, New Hampshire.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01644

THIRTEENTH ANNUAL REPORT, 1963-64.
Mersey River Board.

78 pp, 8 plates, 2 maps.

Descriptors: *Water pollution control.
Identifiers: *Storm sewers, Great Britain.

This report of the Mersey River Board, which is to be superseded by the Mersey and Weaver River Authority, includes a section on the prevention of pollution; a map showing the general condition of rivers and streams in the area, according to a colour-coding scheme; and tabulated data obtained in river surveys. Quarterly chemical surveys of all the major rivers showed a slight improvement in water quality as compared with the previous year and with 6 of the previous 8 years. Sources of pollution and remedial action are outlined and detailed observations are reported on the river Alt, Ditton brook, Sankey brook and Glaze brook. The Board encourages the centralized treatment of sewage in larger plants, the discharge of trade waste waters to sewers, and the construction of separate storm-sewage systems. Observations are being continued on the self-purification and re-oxygenation which occur when a polluted stream passes through a large lake.
W69-01768

POLLUTION CONTROL MEASURES FOR STORM WATERS AND COMBINED SEWER OVERFLOWS,
D. D. Dunbar, and J. G. F. Henry.
Can Mun Utilities (Sewerage Manual and Directory) pp 12-20, 1964.

Descriptors: *Water pollution control, *Storm runoff, *Overflow.
Identifiers: *Combined sewers, *Storm sewers.

Relative importance of other sources of pollution, such as mixtures of storm water runoff and raw sewage being discharged from combined sewer

systems, as well as pollutional capabilities of storm water being discharged from separate sewer systems are assessed, and merits of various control measures examined; review of investigations made to study extent of pollution originating in combined and in separate storm sewer overflows.
W69-01811

RIVER POLLUTION BY STORM OVERFLOWS. AN ATTEMPT AT RATIONALIZATION,
H. C. Gatehouse.
Surv Munic Cty Engr, Vol 123, No 3754, pp 33-34, 37-39, 1964.

Descriptors: *Water pollution, *Storm runoff, *Overflow, Water pollution control, Discharge (Water).
Identifiers: *Combined sewers.

The author criticizes the interim report of the Technical Committee on Storm Overflows and points out various unsatisfactory aspects of the measures recommended for the control of pollution by storm-sewage overflows from combined sewers. He stresses the dangers to health of such pollution, and indicates steps that should be taken to eliminate discharges of untreated storm sewage.
W69-01815

DETOURING CALAMITY IN WATER RESOURCE DEVELOPMENT. A CASE IN POINT: SOUTHEASTERN WISCONSIN,
S. W. Havlick.
Trans Wis Acad Sci Arts Lett, Vol 55, pp 59-76, 1966.

Descriptors: *Water pollution control, Recreation facilities, Groundwater, *Sewers.
Identifiers: *Sewer separation, *Storm sewers, *Sewer infiltration, Milwaukee River (Wis).

After outlining difficulties encountered in the development and management of water resources, including the control of water quality, the author analyses the situation in southeastern Wisconsin with particular reference to the potential utilization of water in the Milwaukee river basin and possible methods for solving the pollution problem. The Milwaukee river is used for industrial water supplies and recreational purposes, but not for potable supplies. Adequate supplies are available from lake Michigan although the costs of treatment are increasing, partly owing to deterioration in water quality. Further deterioration in quality of lake and river water could be prevented by increased waste treatment, separation of sanitary and storm sewers, and climination of ground-water infiltration into the sewerage system. It is also proposed that the increasing demand for recreational facilities could be met by further development of lakes and reservoirs within easy access, and that flood water from a loop of the Milwaukee river could be diverted into lake Michigan and used subsequently to augment the river flow in dry weather.
W69-01821

RIVER-WATER QUALITY CRITERIA IN RELATION TO WATERWORKS REQUIREMENTS,
G. V. Houghton.
Symp on River Management, U. of Newcastle upon Tyne, Sept. 1966.

Descriptors: *Water quality, *Rain, Chemical analysis.
Identifiers: *Storage tanks.

The type of criteria or tests required to provide satisfactory cleanliness for waterworks requirements are reviewed. The equalizing and purifying effects of rain water storage have always been recognized as beneficial, depending on many factors. If there is no storage, the setting of criteria is simplified in that it is known that every peak of river impurity must be handled effectively or else abstraction stopped. Some caution is warranted with toxic substances -nitrates, phosphates and polyphosphates, excremental bacteria, organic content and miscellaneous industrial pollution - since storage can have a profound effect on the concentration of some impurities. The need for sufficiently sensitive and reproduceable analytical procedures is discussed.
W69-01825

PUBLIC HEALTH - WATER SUPPLY.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01938

FUTURE WATER QUALITY DESIGN,
California State Department of Public Health, Berkeley.
Frank M. Stead.
Journal of the American Water Works, Vol. 59, No 12, December 1967, pp. 1497-1501.

Descriptors: Water quality, *Water pollution, *Water quality management, Stream conditions, Standards, Industrial wastes, Public health, Water pollution sources, Municipal wastes, *Waste water disposal, Benefits.
Identifiers: Pathogens, Pesticide pollutions, Total management, Aquatic system.

Pollution control alone will not preserve water quality in the U.S. because it is based on a concept of disposal of wastewaters from municipalities and industries. In both cases the sewage is no longer wanted, and most often put back into the rivers. With half the total annual water replenishment put to use and converted to wastewater, it is important to consider how much dilution is necessary to keep waters up to present standards. There are three basic choices; (1) discharge the entire waste stream to the ocean or evaporate it, (2) through treatment bring the wastewater up to a sufficient level of quality so that when it is diluted it meets standards for all uses, (3) through treatment bring each individual waste stream up to the standard of quality for a specific use and put resulting 'reclaimed' water to that use directly, without returning it to either surface or ground waters. Current standards concerning pathogens and pesticides have not been given enough study to really indicate possible impairment of human health. What is needed is a new water policy for the U.S. -a policy involving total management of water resources. The entire aquatic system must be analyzed and a new system of distribution in terms of benefits must be devised. (Gargola-Chicago)
W69-01982

WATER QUALITY STANDARDS,
James L. Agee.
Journal of the American Water Works, Vol. 59, No. 12, Dec. 1967. p. 1501-1503.

Descriptors: *Water quality, *Standards, Water pollution, Stream improvement, *Wastewater treatment, Industrial wastes, Water quality control, Municipal wastes, Water pollution sources.
Identifiers: Implementation, Waste treatment plants.

Specific attention is given to certain guidelines issued by the FWPCA. The implementation of standards currently being developed to enhance and preserve water quality will guide the overall water pollution control effort. Specific programs: (1) monitoring streams for standards compliance, (2) monitoring effluents from municipal and industrial waste treatment plants, and (3) periodic review of progress being made to construct needed treatment facilities, will be expanded through joint efforts of state and federal programs. One of the biggest needs in pollution control is efficient municipal and industrial waste treatment plant operation. The area of plant operation has been neglected too long; specific programs to perfect treatment plant operations and surveillance of plant operation are needed if stream water quality criteria are to be satisfied. New or expanded activities activities to deal with pollution from erosion, vessels, and marinas, mine drainage, heat discharges, land and agricultural drainage and nutrient enhancement will have to be developed by state and federal governments to meet future needs. (Gargola Chicago)
W69-01988

06. WATER RESOURCES PLANNING

6A. Techniques OF Planning

LAKE SUPERIOR MODEL INDEPENDENT STUDY REPORT,
Wisconsin Univ., Madison, Water Resources Center.
James A. Vierbicher.
Wis Univ Water Resources Center Spec Stud Rep 9 p, May 1967. 3 ref. OWRR-A-004-WIS, OWRR B-009-WIS.

Descriptors: *Model studies, *Hydraulic models *Lake Superior, *Design, *Hydraulic similitude Research and development, Testing, Instrumentation.

A dynamic model of Lake Superior was built t study the effects of winds, shape, stratification coriolis effects, and energy budget on large scal water circulation. The model is built to hav Froude and Rossby numbers similar to those of th lake, distorted horizontal and vertical scales, provi sion for stratification of fluid content, and provi sion for wind to induce circulation and flow pa terns in the turbulent flow regime. The model ma be rotated at 3-300 rpm. The horizontal scale i 1:300,000 and the vertical scale is 1:1,000. (K napp-USGS)
W69-01596

MANUAL ON URBAN PLANNING - CHAPTE VI: COMMUNITY FACILITIES PLANNING,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01787

6B. Evaluation Process

A COMPENDIUM OF MAJOR INTERNA TIONAL RIVERS IN THE ECAFE REGION.
United Nations, Economic Comm for Asia and th East, Bankok, Thailand. Div of Water Resource Dev.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01599

COMPREHENSIVE BASIN STUDY SABIN RIVER AND TRIBUTARIES, TEXAS AN LOUISIANA.
Corps of Engineers, Fort Worth District.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01617

THE WATER RESOURCES OF CHILE,
Resources for the Future, Inc, Washington, D and Inst Latinoamericano de Plan Econ y Socia UNEC for Latin Amer.
Nathaniel Wollman.
Johns Hopkins Press, Baltimore, 1968. 279 p, 6 tab, 3 append, 32 ref.

Descriptors: *Planning, *Metodology, *Economi justification, *Water resources developmen Water policy, Model studies, Irrigation, Wat supply, Mining, Industries, Municipal supplie Water law.
Identifiers: Chile, National water planning study.

The water resources of Chile are examined in detail in a study made to present an example of economic methodology for analyzing national water development planning to engineers, technicians, and administrators. Chile was chosen as an example because of a long tradition of irrigated agriculture and the availability of better hydrological data than can be found elsewhere in Latin America. The model used calculates costs of regulating surface flow to achieve patterns of flow necessary to satisfy regional requirements, including waste dilution to regulate dissolved oxygen, and it calculates waste treatment costs. Total water cost is a function of hydrology and the sum of uses. Future requirements are estimated by projecting population and industrial growth by standard methods. The rate of population growth is 2.43% and GNP growth is 5.5%. There is no foreseeable water shortage in Chile if water supplies are compared with projected requirements. There will be, however, local shortages in drier irrigated areas in the northern provinces. Use of water for agriculture, industry, and municipalities, the cost of water supply and waste treatment, and the effects of shortages are examined in detail. Basic data, including agricultural and industrial production, trends, and predictions, as well as hydrologic data, are compiled in appendixes. (Knapp-USGS)
W69-01654

WATER RESOURCES OF CANADA.
Royal Society of Canada, Toronto.

Toronto Univ Press, 1967. 251 p, 6 parts, misc fig and tab, 31 ref.

Descriptors: *Water resources, Water management (Applied), St. Lawrence River, Great Lakes, Hydrology, Mathematical studies, Eutrophication, Aquatic microbiology, Infiltration, Meteorology.
Identifiers: *Symposia, Interdisciplinary papers, Water export, NAWAPA.

Papers of the 1967 symposia on water resources of the Royal Society of Canada are compiled. The major topics are water export in the NAWAPA plan, water as a resource, the role of the St. Lawrence as a transportation route, the Great Lakes, physico-mathematical studies of water, and the biological necessities and hazards of water. Most of the 23 papers are brief reviews of the subjects covered. Bibliographies list the original papers from which the symposia papers were derived. (Knapp-USGS)
W69-01656

DATA AVAILABLE ON SEPARATING COMBINED SEWERS.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-01715

WATERFRONT RENEWAL IN METROPOLITAN AREAS,
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-01909

THE WATER INDUSTRY AND LOCAL GOVERNMENT,
Henry J. Greaser.
Journal of the American Water Works Association, Vol 60, No. 1, January 1965, p 1-5.

Descriptors: *Local governments, Optimum development plans, Project planning, Water resource development, Federal governments, State governments, Financing, Water rates, Federal jurisdiction, Inter-agency cooperation, Institutional constraints, *Water policy, Water management.
Identifiers: National Water Policy, Guidelines.

The National Water Policy of the American Water Works Association states that the responsibility for water resource development should rest with that echelon of government or private interest closest to the people. The cost should be borne proportionately by those who are benefited. The federal government should only assume the initiative in water resource development when: (1) the project involved is of such magnitude as to beyond the capacity of local groups, (2) a project so complex that no clearly defined local or state group can be identified as principal beneficiaries, (3) federal participation is necessary to assure maximum feasible development in keeping with the comprehensive regional or basin plan, and (4) the programs and projects are not competitive with alternative means of developing water resources by state, local, or private initiative. The state role is clearly delineated in terms of initiative in developments of cooperative water supply projects between agencies of local and federal government. The local systems should bear the primary responsibility for planning, financing, and operating systems for public and industrial water supply. In regard to the funding of projects, criticism of present water rate practices is presented. Now is the time to begin to sell realistic values for water development and water pollution. Everyone in local, state, and federal agencies should seek financial courses which work toward establishing a stable and self-supporting local water and sewage utility and the best way to begin is to get them to pay their own way. (Gargola-Chicago)
W69-01983

TOTAL MANAGEMENT OF WATER RESOURCES,
Office of Science and Technology, Washington, D. C.
Robert L. Smith.
Journal of the American Water Works, Vol. 59, No. 11, November 1967, p 1335-1339, 2 ref.

Descriptors: Economic efficiency, Social needs, Water allocation, *Adminiatrative decisions, *Institutional constraints, Optimum development plans, Multiple purpose, Project planning, Regulation, Local governments, State governments, Several values, *Administration, Adoption of practices, *Non-structural alternatives.
Identifiers: Alternative policies, Total management.

Water management cannot aspire to the fulfillment of all society's demands. What is sought is a rational basis for choice and a maximum of flexibility to cope with changes in the services demanded and in the priority that society accords them. The federal government is now the major financier of water development projects; water management must be responsible, however, to a unique combination of hydrologic, economic, and social needs of much smaller areas. For this reason project details and specific regulatory decisions are based on regional or local conditions, and fall to the jurisdiction of the state. To operate effectively within this jurisdictional structure, an organization involved in water management must have an adequate financial base and a multipurpose water authority. Everyone seems to support the need for planning in water management, but planning is seldom employed in the development of organizational patterns. Total management should prepare optimum plans for alternative objectives, but the final choice should be exercised by society through the democratic process. It may be asserted that there can be no approximation to total management without an organization whose structure is based on institutional, economic, and jurisdictional, as well as hydrologic considerations. Management must be oriented toward planning responsive to subjective values as well as environmental factors. (Gargola-Chicago)
W69-01985

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ALLOCATION OF STORM DRAINAGE COSTS,
Carl W. Porter.
Pub Works, Vol 94, No 3, pp 164-166.

Descriptors: *Rainfall-runoff relationships, *Storm runoff, *Planning, *Legislation, *Flood control, *Land use, Drainage.
Identifiers: Urban drainage.

Article is portion of 'Paper' presented at 1962 American Public Works Congress. It describes program used in the County of Fairfax, Va. Also states that they are working with U.S.G.S. on a pilot program studying 30 main streams in the County endeavoring to determine rainfall patterns and relate runoff from currently developed areas to storm water runoff. Also have an anti-siltation ordinance with SCS. Article discusses plans and ordinances used to protect the suburban homeowner from inadequate drainage and also protect the downstream property owner from flood damage due to increased runoff from newly developed upstream areas.
W69-01891

SUBURB MEETS URBANIZATION HEAD-ON,
Ayers, Lewis, Norris, and May, Ann Arbor, Mich.
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-01895

MEETING FUTURE WATER REQUIREMENTS THROUGH REALLOCATION,
Colorado Univ., Boulder, Department of Civil Engineering.
J. Ernest Flack.
Journal of the American Water Works, Vol. 59, No. 11, November 1967, pp. 1340-1350, 2 tab, 16 ref.

Descriptors: *Water resource development, Water supply, *Water allocation (Policy), Water requirements, Alternative costs, Market values, *Equitable apportionment, Water law, *Legal aspects, Riparian rights, Stream conditions, Capital, Future planning, Water consumption, Economic efficiency, *Water transfer.
Identifiers: California, South Pacific Region, Area of origin right.

Reallocation of water becomes increasingly necessary as readily available sources are exhausted and surplus water becomes more expensive to develop. Unless new sources of water are developed or consumptive uses drastically reduced, the projections of needed water withdrawals for certain areas cannot be realized. The distribution of water shows the South Pacific region will suffer the most severe deficiency of supply for the future. The relative use of water for residential, agricultural, industrial, and urban purposes is discussed, and possible means of reducing these uses given. In discussing the valuation of water rights for purposes of reallocation eight points are considered: (1) cost of acquisition of the original rights, (2) market value, (3) appreciation and depreciation, (4) sale of stock, (5) alternative costs, (6) capitalized earning method, and (7) value in use. The value of reserved rights now in use in California permits the area of orgin to exercise a type of riparianism. In order to make an economic allocation of water and still retain some protection for counties of origin certain points would have to be established; (1) quantify the area of origin right and give it priority (2) condemnation of water rights, (3) engineering studies to determine water use before and after the transfer, (4) measuring return flow, (5) maintenance of stream conditions and (6) limiting transfers to new users defined in the public interest. (Gargola-Chicago)
W69-01984

WATER PRICING IN RESIDENTIAL AREA,
Charles W. Howe.
Journal of the American Water Works Assn., Vol. 60, No. 5, p 497-501, 1 fig, 1 ref.

Descriptors: Costs, Demand, *Water values, Prices, Competition, *Water demands, *Water costs, Use rates, Market value, Elasticity of demand, Unit costs.
Identifiers: Revenue, Commodity.

A framework is suggested to bring cost-demand considerations together to determine water prices with emphasis on demand for residential water. Applying such a framework to the provision of water service to a residential subdivision involves many complexities. The complexities start with trying to develop a relevant and adequate measure of output and of forecasting water demands. Three measures of demand are discussed: (1) domestic demands on an average annual basis, (2) average summer sprinkling demand, and (3) maximum day sprinkling demand. The amount of water demanded for these purposes is affected by the price charged. In designing new systems or sub-systems that depend on quantity demanded, price is a vital factor. The steps in the design process are: (1) demand forecasts, (2) system design, (3) system costs, (4) pricing, and (5) actual demand. They can be made consistent only if the price demand relationships are taken into account and the proper division made between commodity and fixed charges in the rate structure. (Gargola-Chicago)
W69-01986

BILLING FREQUENCY AND CUSTOMER RELATIONS,
Umbaugh and McQueen, Plymouth, Indiana.
H. J. Umbaugh.
Journal of the American Water Works Association, Vol. 59, No. 6, p 669-674.

Descriptors: Unit costs, Water cost, *Water rates, Water values, Use rates, Public benefits, *Social aspects, Pricing, Economic efficiency, Political aspects, Water users.
Identifiers: *Water billing frequency, Public relations.

Water billing frequency is a judgment decision having many sides, economic, social, and political. In a municipal situation the frequency of billing could be a political decision. Customer relations are greatly affected by this; greater frequency of billing might soften the shock of higher priced service and sewage billing. In smaller communities more frequent billing is influenced by two factors: (1) new sewage plants create a substantial additional burden upon water usage, (2) capital improvement of water facilities can result in a considerable water rate increase. A change from quarterly to monthly billing can help users to adjust to increased costs, especially those on fixed budgets, such as the elderly and welfare recipients. The loss of revenue that could result from a shift to monthly billing is discussed and certain factors of loss mentioned. Greater frequency of billing does allow for better maintenance of the system through early detection of leaks and line losses. The deposit required is discussed and public relation factors considered. Billing frequency should bear some relation to size of billing. In communities where standard charges are less quarterly billing may be quite feasible, but where charges are high and sewage billing on the same account, monthly billing can allow for easier financial adjustments by customers. The ideal situation would be to provide the customer with the billing frequency he finds easiest to adjust to. This is not possible now, but perhaps future developments in technology will allow it. (Gargola-Chicago)
W69-01987

CHALLENGES IN THE WATER INDUSTRY,
For primary bibliographic entry see Field 03D.
For abstract, see .
W69-01989

6D. Water Demand

THE WATER RESOURCES OF CHILE,
Resources for the Future, Inc, Washington, D C and Inst Latinoamericano de Plan Econ y Social, UNEC for Latin Amer.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-01654

PROPOSALS FOR STUDYING THE FEDERAL-STATE WATER RIGHTS PROBLEM,
Los Angeles Department of Water and Power.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01981

6E. Water Law and Institutions

CONSTRUCTION AND MAINTENANCE OF SEWERS AND DRAINS.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01926

TURNER V WASHINGTON SUBURBAN SANITARY COMMISSION (EASEMENTS AND DISCHARGE OF SURFACE WATERS).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01928

JOHNSON V SEIFERT (RIPARIAN OWNER'S RIGHT TO USE OF ENTIRE LAKE SURFACE).

100 N W 2d 689-697 (Minn 1960).

Descriptors: *Minnesota, Judicial decisions, *Riparian rights, Lake beds, Ownership of beds, Riparian land, *Diversion, *Lakes, Navigable waters, Non-navigable waters.

Plaintiff riparian owner brought suit against defendant co-riparian owner to enjoin his restriction of plaintiff's use of two lakes by maintaining a fence through them, and from withdrawing water from the lakes for irrigation. Defendant had constructed a fence along his property line, through the lakes, cutting off plaintiff's access to the main portions of each lake. Defendant contended that the lakes were non-navigable and that plaintiff only had a right to the use of the water over the property he owned. On appeal, the Minnesota Supreme Court held that riparian rights arose from ownership of the shore, not the lakebed, and that each riparian owner had a right to use the entire surface of the lake in common with other riparian owners. The court expressly overruled Lamprey v Donz 86 Minn 317, 90 NW 578, in holding that whether a lake is navigable or non-navigable does not effect riparian rights. The federal test of navigability is not binding. The court also held that the withdrawal for irrigation was reasonable. Defendant only owed a duty to plaintiff not to unreasonably lower the lake level. (Williams-Fla)
W69-01929

BLAKE V UNITED STATES (OBSTRUCTIONS IN NAVAL ANCHORAGE AREA).
181 F Supp 584-591 (E D Vir 1960).

Descriptors: *Federal government, *Rivers and Harbors Act, Navigation, *Rivers, Oysters, Channels, Leases, State jurisdiction, State governments, Navigable rivers, Compensation, *Bouys, Navigable.
Identifiers: Navigation obstructions.

Libellants in this case were lawful holders of oyster ground leases, issued under the laws of Virginia. These grounds were in the lower York River. The United States Government established, in the same general area, a naval mine sweeping practice area and a naval drill minefield area. Public hearings were held prior to this action, and public notice of the hearings was given, although there was no personal notice to the libellants. Certain portions of libellants' grounds were within these restricted areas, and the stakes and bouys used to mark the boundaries were removed by the Navy. Libellants contended that this action rendered their grounds valueless, therefore constituting a taking for which the Fifth Amendment required just compensation. The court held that even though the markers and bouys were private property as contemplated by the constitutional provision, the federal government has a dominant power over navigation. Thus congress may provide for removal of obstructions to navigation, as in the Rivers and Harbors Act. Such a removal is not a 'taking' requiring compensation. (Williams-Fla)
W69-01930

JOINER OF PARTIES WHEN LITIGATING WATER RIGHTS,
W. Patterson.
Baylor L Rev, Vol 11, No 2, pp 181-192, Spring 1959. 12 p, 18 ref.

Descriptors: *Water rights, *Texas, *Adjudication procedure, Water law, Legal aspects, Water utilization, Natural flow, Diversion, Relative rights, Water users.
Identifiers: *Joinder of parties.

Laws concerning parties litigating water rights controversies are discussed. There are three classifications of parties: (1) 'proper'; (2) 'necessary'; and (3) 'indispensable.' Texas courts have repeatedly treated necessary and indispensable parties alike. Cases which indicate the confused state of the law concerning the necessity or indispensability of parties are considered. The author also discusses class actions in water rights controversies. The Texas law is unclear as to when class actions are appropriate. The author points out that the major cause of the confusion in the law is the inaction of the legislature. (Horner-Fla)
W69-01931

JONES V DES MOINES AND MISSISSIPPI RIVER LEVEE DIST NO 1 (LEVEE DISTRICT'S LIABILITY FOR OVERFLOW).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01932

INTERNAL IMPROVEMENT TRUST FUND.

Fla Stat 253 secs 253.01--253.05, pp 1197-1200 (1967).

Descriptors: *Administrative agencies, *Florida, Land management, Land tenure, Conservation, Surveys, *Ownership of beds, Beds, Bays, Beds under water, *Legislation.
Identifiers: Internal improvement trust fund, Tidal lands, Swamp lands.

Florida, by statute, established a distinct trust fund comprised of the title to and revenues from the sale of specified state lands. Swamp and overflow lands held by the state, all land held by right of sovereignty, all internal improvement lands, all tidal lands and other enumerated lands, make up the land holdings of the fund. Title to the land and control and administration of the fund are vested in the governor and the cabinet as trustees. They are required to maintain a land office with complete records on all fund land and to prosecute any suit deemed necessary for the protection and preservation of fund lands. They are responsible for creating a comprehensive plan for management, acquisition, and disposition of state owned lands to insure maximum benefit and use. (Geraghty-Fla)

W69-01933

INTERNAL IMPROVEMENT TRUST FUND.

Fla Stat 253 secs 253.111--253.128, pp 1200-1206 (1967).

Descriptors: Highwater mark, Boundaries (Property), Riparian land, Riparian rights, Sand bars, *Bulkhead line, Hydrographs, *Landfills, Ecology, *Conservation, Recreation facilities, Local government, Wildlife, *Legislation, Dredging.
Identifiers: Internal improvement trust fund.

The trustees, before disposing of land to which they hold title, must afford the county in which such land is situated an opportunity to receive such land for public purposes. However, if a riparian owner shall exist, his right to secure such land shall be prior in interest to the county's. The title to all sovereignty tidal and submerged bottom lands, including islands and sand bars created by dredging, is vested in the trustees of the fund. Before this land can be sold, it must be determined to what extent such conveyances would interfere with the conservation of marine, wildlife or other natural resources. The State Board of Conservation, after hydrographic surveys and ecological studies, makes recommendations to the trustees as to the probable effect on the area's resources. Local governments have the power to fix bulkhead lines subject to approval by the trustees. Once established, any extension creating or filling of land beyond such lines into county waters shall be deemed an interference with navigation. Removal of sand, rock or other material from navigable waters of the state to be used as fill is prohibited unless provided for in a construction permit. Any person, natural or artificial, wishing to construct islands or add to existing lands bordering on or in the navigable waters of the state, must obtain a permit to do so from the county wherein such construction is desired. (Geraghty-Fla)
W69-01934

NTERNAL IMPROVEMENT TRUST FUND.

Fla Stat 253 secs 253.129--253.601, pp 1206-1215 1967).

Descriptors: Construction, *Riparian rights, Railoads, Land tenure, *Legislation, Legal aspects, Drainage programs, Marshes, Phosphates, Oil, Leases, Surveys, Federal government, *Administrative agencies, Riparian land.
dentifiers: Homestead, Internal improvement trust und.

itle to all lands filled or developed prior to the nactment of this statute is vested in the upland wners. Private riparian owners may bring suits to njoin the sale of fund lands, if such a sale would eprive them of riparian rights granted by law. anal and railroad construction is encouraged by rants of fund land under specified conditions, hich include forfeiture if construction is not egun within a prescribed period. The trustees are mpowered to borrow money for draining and eclaiming specified swamplands. There is also a ovision for homesteading certain lands held by e fund. Title to permanently reclaimed marsh nds belonging to the state is vested in the trustees the fund. Surveys must be made of such land and it is sold, first right to purchase must be given to e adjoining owner. Unsurveyed marsh lands are be sold to the record owners of uplands which ve been surveyed by the United States. The ustees may exchange fund lands with private inviduals or corporations and enter into agreeents for the sale or lease of mineral rights on fund nd or for the lease or sale of gas and oil rights on e bottoms of specified bodies of water. eraghty-Fla)
69-01935

EXTINGUISHMENT BY PRESCRIPTION OF NATURAL SERVITUDE FOR DRAINAGE OF SURFACE WATERS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01936

SEC 5E TO ISSUE LICENSE FOR APPLICATION OF CHEMICALS TO WATERS FOR CONTROL OF AQUATIC NUISANCES, ETC. SEC 5F TO CONTROL ALGAE, WEEDS AND AQUATIC NUISANCES IN CERTAIN BODIES OF WATER, ETC.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01937

PUBLIC HEALTH - WATER SUPPLY.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01938

SARGENT V GAGNE (EASEMENT TO USE OF WATER SUPPLY ON THE LAND OF ANOTHER).
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-01939

WESTBURY REALTY CORP V LANCASTER SHOPPING CENTER, INC (ARTIFICIAL USE OF LAND GIVES RESPONSIBILITY FOR INCREASED SURFACE WATER FLOW).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01940

ROCKWELL V STATE (HIGHWAY DRAINAGE).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01941

NOLAN V CARR (MUNICIPALITY'S LIABILITY FOR SURFACE DRAINAGE).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01942

MATZOK V GLEN COVE YACHT SERVICE REPAIR, INC. (EASEMENT OF ACCESS TO NAVIGABLE PORTION OF STREAM).

189 NYS 2d 249 (Sup ct NY 1959).

Descriptors: *Easements, *New York, *Riparian rights, Dredging, Streams, Navigable rivers, Judicial decisions, *Intertidal areas, Riparian land, Banks.
Identifiers: Upland.

Plaintiffs sought judgment establishing an easement over adjoining property, the purpose being to enforce alleged riparian rights. One of the plaintiffs' predecessors in interest owned upland and part of the foreshore bordering on the creek. The deed to plaintiffs had expressly included riparian rights. After dredging operations no part of plaintiffs' property touched on a navigable portion of the creek. Defendant, who was the successor in interest to the remaining property, filled in the foreshore and created a lot. The court found that the fact that part of a foreshore is owned by another, and filled in by him so as to transform foreshore into upland, does not deprive the owner of adjacent foreshore from asserting riparian rights. An easement was granted allowing access to the navigable part of the stream, but not entitling plaintiffs to unreasonably interfere with the use of the property. (Kahle-Fla)
W69-01943

BOSTICK V SMOOT SAND AND GRAVEL CORP. (RIGHTS OF RIPARIAN OWNERS TO CONTROL THE REMOVAL OF SAND AND GRAVEL).

260 F 2d 534-541 (4th Cir 1958).

Descriptors: Judicial decisions, *Maryland, Virginia, *Dredging, Permits, Legislation, Legal aspects, *Boundaries (Property), Low water mark, *Ownership of beds, High water mark, Riparian waters.
Identifiers: *Riparian owners, Potomac River.

Appellants were owners of property in Virginia on the Potomac River. Appellee was a corporation engaged in dredging and removing sand and gravel from the Potomac River between the low water mark on the Virginia side, which was the boundary line between Maryland and Virginia, and the outer line of the channel on the Virginia side. Appellee worked under a license granted by the United States Corps of Army Engineers, but did not acquire the permission of the appellants. Appellants brought an action in trespass, for nuisance. The court held that appellants were contemplated by the Maryland statute that prohibited removal of sand and gravel from the area in which appellee was dredging, except by riparian owners of land bordering the Potomac River. Appellees, therefore, were liable for damages and for removal of the sand and gravel without appellant's permission. (Sisserson-Fla)
W69-01944

UNITED STATES V BIGAN (VIOLATION OF RIVERS AND HARBORS ACT).

170 F Supp 219 (E D Pa 1959).

Descriptors: *Overburden, *Pennsylvania, Federal government, *Rivers and Harbors Act, Strip mines, Banks, Barriers, Structures, Obstruction to flow, Navigable rivers, Judicial decisions.
Identifiers: Allegheny River, Nuisance, Injunctions.

Plaintiff sought prohibitory and mandatory injunctions against defendant for alleged violations of sections 9, 10, 12, and 13 of the Rivers and Harbors Act. Defendant in carrying on strip mining operations, had deposited overburden on an abandoned road 500 feet above the Allegheny River. Heavy rains subsequently washed the overburden down the bank, carrying uprooted trees and underbrush with it into the river and thereby creating a bar. The court found that section 9, prohibiting constructions in navigable rivers, was not violated. Section 10, also prohibiting obstructions, is penal, and implies intentional acts. It was not shown that defendant willfully intended an obstruction. Defendant did violate the first part of section 13, which makes it unlawful to deposit refuse in navigable waters. However, since defendant had abandoned mining operations, a prohibitory injunction was not granted. Defendant did not violate the second part of section 13, making it unlawful to deposit material on the bank of navigable waters, since the road 500 ft. above the river could not be considered a bank. The bar is not within section 12, which restricts statutory injunctive power to structures in violation of sections 9, 10, and 11. The plaintiff is not entitled to mandatory injunction for removal because it does not appear that the bar is a public nuisance. (Kahle-Fla)
W69-01945

YEATES V MILLSAPS (OIL POLLUTION).
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-01946

BOARD OF COMM'RS V BARON (DISTRICT NOT ALLOWED TO APPROPRIATE NON-RIPARIAN LAND FOR LEVEES AND DRAINAGE).

236 La 846, 109 So 2d 441-444 (1959).

Descriptors: Judicial decisions, *Louisiana, *Riparian land, *Levees, Administrative agencies, Appropriation, Drainage, Streams, Navigable rivers, Public utility districts, Ditches, Mississippi River, *Eminent domain.

The district commissioners sought to evict the defendant from land appropriated by the district for levees and levee drainage purposes. The defendant lost at the trial court, but the decision was reversed on appeal. The district based its appropriation on a La statute which imposes a servitude in favor of the public upon lands adjacent to navigable rivers and streams for the purpose of constructing and repairing levees, roads and other public or common works. The property in question, however, was adjacent to a man-made drainage ditch which was located over 3 miles from the nearest navigable river or stream. Since the land was not riparian, it could not be appropriated under the statute. (Watson-Fla)
W69-01947

HOLBROOK V MASSACHUSETTS TURNPIKE AUTHORITY (ACTIONS FOR DAMAGES BY LANDOWNER FOR FLOODING CAUSED BY FILLING LAND TAKEN BY EMINENT DOMAIN).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01949

BLUMER V WISCONSIN RIVER POWER CO. (LANDOWNER'S SUIT AGAINST DOWNSTREAM DAM OWNER FOR RAISING THE WATER TABLE).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01950

RAND V MILLER (ACTION TO QUIET TITLE TO ACCRETION LANDS SEPARATED FROM RIPARIAN LANDS BY AVULSION).
95 NW 2d 916-920 (Iowa 1959).

Descriptors: Judicial decisions, *Iowa, Riparian rights, Missouri River, *Accretion (Legal aspects), *Alluvion, Navigable rivers, High water mark, Boundaries (Property), Interstate compacts, Channels, *Alluvial channels, Dikes.

Suit to quiet title was brought by an Iowa riparian owner claiming title to certain lands by accretion, deed, and adverse possession. The plaintiff won at the trial court, and the decision was affirmed by the Supreme Court of Iowa. The land in question accreted to the plaintiff's land on the Iowa side of the Missouri River from a period prior to 1912 until the mid-1940's. In 1946 or 1947, the river changed courses detaching the land in question from the Iowa side and attaching it to the Nebraska side of the river. The court held that the plaintiff had acquired good title to the land and it was still his although now on the Nebraska side of the river, the land was identifiable, and the Army Corp of Engineers planned to reroute the river to its former channel. (Watson-Fla)
W69-01951

CITY OF MADISON V TOLZMANN (CITY ATTEMPTING TO REQUIRE A LICENSE TO OPERATE BOAT UPON NAVIGABLE STATE WATERS WITHIN ITS JURISDICTION).
7 Wis 2d 570, 97 N W 2d 513-517 (1959).

Descriptors: *Wisconsin, Judicial decisions, Legislation, *Cities, Mississippi River, Lakes, Rivers, Streams, Taxes, *Navigable waters, *Jurisdiction, Boating regulations, St. Lawrence River, Permits, Fishing, Swimming, Navigation, Skiing, Beds, Ownership of beds.
Identifiers: Public trust doctrine.

The city of Madison, Wisconsin, imposed a fine on the defendant for violation of city ordinances by unlawful operation of a boat upon navigable water subject to city jurisdiction without registration of the boat and not having a life preserver for each person. The Supreme Court of Wisconsin affirmed the portion of the judgment pertaining to the life preservers, but reversed the fine for operating a boat without a license. The Supreme Court held that in view of a constitutional provision that the state should have concurrent jurisdiction over navigable waters leading into the Mississippi and St. Lawrence rivers, even if the state had delegated to the city the authority to enact safety regulations, the city had no implied power to enact, as a means of enforcement of such regulations, a boat registration and licensing ordinance provision which resulted in an exaction of fees for the use of navigable waters which were within the city's boundaries. Beds of navigable waters are held by the state in trust for use by the public, and the trust doctrine applies not only to rivers or lakes forming a common boundary to the state but also to inland navigable meandered lakes. (Watson-Fla)
W69-01952

WISEMAN V TOMRICH CONSTRUCTION CO (ACTION FOR DAMAGES FROM WRONGFUL DIVERSION OF SURFACE WATERS THROUGH STORM DRAIN).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01953

NANTAHALA POWER AND LIGHT CO. V HORTON (CONDEMNATION VALUE OF RESERVED WATER RIGHTS).

249 N C 300, 106 S E 2d 461-467 (1959).

Descriptors: Condemnation, *Condemnation value, Eminent domain, Easements, Legal aspects, *North Carolina, Dams, Backwater, Floods, *Water rights, Mining, Compensation, Impounded waters, Hydroelectric power, Access routes, Judicial decisions, Real property.
Identifiers: Tuckaseegee River, Mineral rights.

A power company condemned easements giving it the right to build a dam on its own property and thereby impound waters which would flood a portion of a tract in which respondents each claimed an interest. The condemnor was ordered to pay $11,500. The rights of all respondents depended upon the legal effect of a deed conveying the fee subject to certain 'exceptions, limitations and reservations' which, entitled the grantor and his successors to the mineral and water rights. Respondents Horton and Stnikeleather were successors in interest of the grantor and grantee respectively. Horton contended that, since he owned the water power rights in the tract, which were all the power company acquired by condemnation, he was entitled to receive the entire $11,500. The court held that the deed in question vested in Horton only such water rights susceptible to development within the tract. The easement condemned gave the Power Company substantially greater rights than were possessed by Horton. The amount of compensation was proportionate to the loss shown to have been proximately caused by condemnation. No evidence was introduced showing Horton sustained more than nominal damages, and hence Stnikeleather, owner of the fee, was entitled to the $11,500. (Bozarth-Fla)
W69-01954

AETNA INSURANCE CO. V WALKER (MEANING OF SURFACE WATERS).

98 Ga App 456, 105 S E 2d 917-921 (1958).

Descriptors: *Georgia, Judicial decisions, Surface drainage, Surface runoff, *Surface waters, *Standing waters, *Spring waters, Insurance, Risks.

Insured, Walker, brought suit against the insurer under a policy protecting his property from all physical loss, subject to certain exceptions, one of which was damage from surface water. The insured claimed he suffered damage from seepage from three subterranean springs which caused waters to stand around and seep into the foundation of his house. The insurer defended the suit on the ground that the damage to plaintiff's property fell into the class excluded from coverage under the policy. On appeal, the Georgia court of appeals, held that the damage described by plaintiff was caused by surface water as contemplated in the policy exception. The court held that surface waters include both rain water and water that arises from springs, which diffuses itself over the ground and neither follows nor gathers itself into a definite channel. (William Fla)
W69-01955

LETTERMAN V ENGLISH MICA CO. (FLOODING ABOVE DAM).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01956

WEST KY COAL CO V RUDD (ACTION BY FARM OWNER AGAINST 8 COAL MINING CO'S TO ENJOIN DISCHARGE OF COAL WASTES).
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01957

CORRINGTON V KALICAK (LIABILITY FOR CAUSING FLOOD BY OBSTRUCTING STREAM).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01958

CITY OF SPRINGFIELD V MECUM (VALIDITY OF CITY BOATING ORDINANCE).
320 S W 2d 742-748 (Ct App Mo 1959).

Descriptors: *Missouri, Lakes, Judicial decision *Cities, *Boating, Legislation, Local governme Ownership of beds, *Regulation, Public rights.
Identifiers: Police power.

Defendants were convicted of violating a city dinance which forbade the use of an outboa motor of over six horsepower on Lake Springfie This lake was created by a dam and was on la owned by the city. Defendants appealed and t Springfield Court of Appeals held that the dinance was a valid and reasonable exercise of t police power granted by statute to the city, allo ing it to police lands owned by the city and used the public, whether within or without the corpor boundaries. (Williams-Fla)
W69-01959

REMOVABLE BRIDGES OVER CERTA CANALS - SEWAGE DISPOSAL IN HIGHW DITCHES - DRAINING OF PUBLIC ROADS.

La R S 1965 48: 383, 385, 483.

Descriptors: *Louisiana, *Legislation, *Admi trative agencies, Canals, Bridges, Bridge constr tion, Bridge design, *Highways, Road constructi Drainage, Irrigation, Canals, Floats, Dredgi Ditches, Sewage, Effluents, Public health.

Bridges which are built over a drainage or irrigat canal which was dug or may be subject to clean by a floating dredge must be of a design appro by the Chief Engineer of the Department Highways which shall permit quick, easy, and e cient removal and replacing to facilitate the cle ing of the canal. No industrial wastes, sewage, s tic tank effluent, nor any noxious or harm matter, solid, liquid, or gaseous, may be dischar into the side or across ditches or placed upon rights of way of state highways, without having obtained the prior written consent of the Direc

of Highways and the La State Board of Health. The Parish governing authorities are authorized to drain the public roads of their parishes by cutting ditches and canals where necessary through private property. The ditches and drains must be of sufficient size to drain both the public road and the lands over which they are opened. They must also be located where least injurious to the owner of the property. (Watson-Fla)
W69-01960

LAYING-OUT OF ROADS - WHAT ARE PUBLIC ROADS - COMPENSATION OF OWNERS.
La R S 1965 48:491, 493.

Descriptors: *Louisiana, *Legislation, *Highways, Rivers, Bayous, Cities, Damages, Beds, Alluvium, Accretion (Legal aspects), Riparian rights, Navigable rivers, Navigable waters, Watercourses (Legal), *Eminent domain, Condemnation value.

All roads built or maintained for 3 years by any governmental authority are deemed public roads. Also all roads or streets made on the front of their respective tracts of lands by individuals when the lands have their front on any of the rivers or bayous with the state shall be public roads and streets. Any person through whose land a public road is laid out may claim just compensation to be determined by a jury and paid by the parish. Compensation is not available, however, to any person whose land is considered a public road because the front of it runs along a navigable river or watercourse within the state. (Watson-Fla)
W69-01961

AMERICAN CYANAMID CO. V SPARTO (INDUSTRIAL POLLUTION).
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-01962

TRANSFER OF LANDS BY LEVEE BOARDS AND SCHOOL BOARDS--DYKES OR DAMS--EXCAVATIONS.
La R S 1965 56:723-724.

Descriptors: *Louisiana, *Legislation, *Administrative agencies, Levees, Streambeds, Ownership of beds, Non-navigable waters, Streams, Overflow, Wildlife habitats, *Wildlife management, Wildlife conservation, Preservation, Game birds, Fish management, Dams, Canals, Lakes.

Levee boards and school boards owning land in the beds of non-navigable streams, where the lands are annually overflowed, may sell the lands to any parish for the purpose of establishing a game or fish preserve. The governing authority of a parish may build dykes or dams, dig canals, or excavate lake or stream beds whenever such work is necessary to the creation and establishment of these preserves. (Watson-Fla)
W69-01963

DEFINING INSIDE AND OUTSIDE SHRIMPING WATERS.
La R S 1965 (1968 Supp) 56:495.

Descriptors: *Louisiana, *Legislation, *Fishing, *Fish management, Mississippi River, Water, Lighthouses, Islands, Beaches, Bayous.
Identifiers: Shrimp.

The shrimping waters of the state of Louisiana are divided into two classes, inside and outside waters. The dividing line between inside and outside waters is a line commencing from the mouth of Sabine Pass in an easternly direction following the offshore beaches to South Point on Marsh Isle, thence in a direct line to Eugene I Lighthouse; then continuing in an easternly direction along the beaches to the west end of Isles Dernieres and then easternly along the beaches of Isles Dernieres, Wine Isle and Timbalier Islands to the Mouth of Bayou Lafourche; then eastward along the beaches of the mainland mass including Grand Isle and Grand Terre to the Mississippi Delta; then along the shores of the Mississippi Delta, excluding the passes of the River to Bird Island; thence in a northeasterly direction to and along the beaches of the Breton Island and Chandeleur Island complex to the Mississippi line. Map is attached. (Watson-Fla)
W69-01964

DEVELOPMENT OF IRRIGATION DISTRICTS.

Ala Const Ammend no 227.

Descriptors: *Alabama, *Legislation, Administrative agencies, *Irrigation districts, Water contracts, Water conservation, United States, Cities, *Financing, Electric power, State governments, Local governments.
Identifiers: Counties, Bonds.

The legislature of Alabama may by general, special, or local laws authorize the formation of a body corporate for the development of one or more irrigation districts for the purposes of providing irrigation and water conservation in the state. The legislature may also authorize: (1) the counties and municipalities lying within the boundaries of such districts to contribute public funds to the district; (2) the corporate body to enter into contracts with the United States, other states or their political subdivisions, and other irrigation districts; (3) the corporate body to issue revenue bonds payable solely out of revenue accruing to it; and (4) the corporate body to do all other acts necessary and proper for the full development of the irrigation district except the production, transmission, or sale of electric power. (Watson-Fla)
W69-01965

NAVIGABLE WATERWAY BETWEEN DEMOPOLIS AND TENNESSEE RIVER AND FLOOD CONTROL PROJECTS ON TRIBUTARY STREAMS OF TOMBIGBEE RIVER.

Ala Const Ammend no 270.

Descriptors: *Alabama, *Legislation, *Administrative agencies, *Financing, Navigable rivers, Rivers, Navigable waters, Flood control, Streams, Channels, Tennessee River, Tributaries, United States, Interstate compacts.

The legislature of Alabama may by appropriate laws authorize the state to engage in works of internal improvement by fulfilling the requirements of local contribution, participation, and cooperation established by the United States in connection with the construction and maintenance of a navigable waterway between Demopolis, Ala and the Tennessee River and the implementation and maintenance of flood control projects on the tributary streams of the Tombigbee River. The legislature may also issue bonds, not exceeding $10 million, pledging the full faith and credit of the state to pay for these projects. The legislature is further authorized to create a public corporation to administer the funds provided. (Watson-Fla)
W69-01966

NUISANCES: MANUFACTURING PLANT NOT A NUISANCE AFTER OPERATING FOR ONE YEAR; DAMAGES ON ACCOUNT OF POLLUTION OR OVERFLOW OF STREAM.
Ala Code, tit 7, secs 1088-1089 (1958).

Descriptors: *Alabama, Legislation, *Water pollution, Overflow, Damages, Flood damage, *Industrial plants, Industrial wastes, Legal aspects.

Section 1088 declares that a manufacturing plant is not a nuisance after operating for one year when it was not a nuisance when the operation began, unless a nuisance results from negligent or improper operation of the plant. Section 1089, however, preserves the right of any person, firm, or corporation to recover damages for any injury sustained on account of any pollution of the waters of any stream or any overflow of the lands of any person, firm, or corporation. (Sisserson-Fla)
W69-01967

WATERSHED CONSERVANCY DISTRICTS.
Ala Code, tit 2, secs 670 (1)- (17) (1958).

Descriptors: *Alabama, *Legislation, *Administrative agencies, *River basin commissions, Erosion control, Flood control, Water conservation, Watersheds (Basins), Water utilization, Watershed management, Soil conservation, Financing, Project feasibility.

The procedure for formation and discontinuance of watershed conservancy districts is given. The districts may be formed to develop and execute programs in the conservation of water, water usage, flood prevention, flood control, erosion prevention, and control of erosion, floodwater and sediment damages. The land embraced in any district must be contiguous and lie within a well defined watershed. To form a watershed conservancy district a petition must first be filed with the board of supervisors of the soil conservation district in which it is located. After the petition is received and adequate notice has been given a public hearing is conducted by the board of supervisors to determine the practicability and feasibility of creating the proposed subdistrict. If approved at the hearing, a referendum will be held within the proposed district to see if a majority of the landowners approve the proposed district. If approved by referendum the watershed conservancy district is created. The powers of the directors and the procedures for their election are given. Procedures for modification of the district and conducting referendums on proposed bond issues are also listed. (Watson-Fla)
W69-01969

ERECTION OF DAMS FOR MILLS, GINS OR FACTORIES.
Ala Code tit 19, secs 34-55 (1958).

Descriptors: Hydroelectric plants, *Alabama, Damages, Flood damage, Dam construction, *Damsites, *Non-navigable waters, Mills, Industrial plants, *Legislation, Eminent domain, Public benefits.

Permission to erect a dam for any mill, factory, or gin across any non-navigable watercourse may be granted to the fee owner of land on one or both sides of the watercourse by application to the probate court of the county where the dam is to be erected. Since the proceeding is eminent domain, the structure must be operated for the public. Upon application and notice to the opposite owner 7 jurors will assess possible damage to surrounding land and the value of one acre of opposite land. If the court finds that no residence, outhouse, enclosure, garden, orchard, or other mill will be overflowed and that health will not be endangered, the application will be granted. The applicant must pay the assessed damages and the value of the acre of land within 3 months or the grant will be revoked. Payment for the acre vests fee ownership in the applicant, but failure to construct and maintain the dam within time limits will cause reversion to the former owner. Permission to raise a dam or put a canal through another's land may be granted under the same proceedings. Failure to comply gives rise to double damages. Landowners may appeal to the Circuit Court as a matter of right concerning damages or by certiorari as to irregularities in the proceedings. (Kahle-Fla)
W69-01970

LEASE OF LANDS UNDER NAVIGABLE WATERS, ETC (DEVELOPING MINERAL, GAS, AND OIL RESOURCES).
Ala Code, tit 26, sec 179 (56 L) (1958).

Descriptors: *Alabama, Legislation, Administrative agencies, Gulf of Mexico, Resources, *Natural resources, Oil, Navigable waters, *Ownership of beds, Riparian rights, Minerology, Conservation, High water mark.
Identifiers: *Mineral rights.

Section 179 (56L) authorizes the director of conservation to lease any lands, rights or interests under any navigable waters of the state, including that in the Gulf of Mexico within the seaward boundary of the state (six leagues from the land bordering the gulf) for the purpose of exploration, development, and production of oil, gas, and other minerals. The department of conservation shall supervise and manage such lands and interests. (Sisserson-Fla)
W69-01971

WELLS, CISTERNS: CARE OF.

Ala Code, tit 37, sec 501 (1958).

Descriptors: *Alabama, *Legislation, Wells, *Well screens, Well regulation, Water wells, Cisterns, Rainwater, Cities, *Mosquitoes, Insects, Drains, Stagnant water, Weed control, Weeds, Surface drainage, Surface waters.
Identifiers: Liens.

All cities and towns of the state have the power to construct repair, and regulate public wells and cisterns. The cities and towns also may compel screening of all wells, cisterns, and other places in such cities and towns where water is collected and mosquitoes or other insects are apt to propagate. The cities and towns are further empowered to compel the proper setting of gutters so as to prevent stagnant water from collecting, and to require weeds to be cut or other things or conditions favorable to the harboring of such insects to be abated. All such work is to be done at the expense of the owner, and if it is not collected a lien will be imposed on the property. (Watson-Fla)
W69-01972

RIGHT OF WAY FOR WATER FLOW CITY CAN ACQUIRE THROUGH EMINENT DOMAIN CONDEMNATION.

Ala Code, tit 37, secs 508 and 510 (1958).

Descriptors: *Alabama, *Legislation, *Cities, Eminent domain, *Right-of-way, Water supply, Sewerage, Drainage, Condemnation, Damages, Judicial decisions.

Whenever the city deems it necessary it can acquire a right of way through private property to obtain a water supply, or for sewage or drainage purposes. The mayor is authorized to purchase the land, or if that is not possible, to acquire by condemnation proceedings. When an appeal is taken by the landowner from a condemnation proceeding it does not deprive the city from entering onto the land for the purposes of the condemnation if all damages have been paid into court and a bond of twice the damages has been given.
W69-01973

SEWERS, DRAINAGE, ETC - GENERAL PROVISIONS.
Ala Code, tit 37, secs 601-607 (1958).

Descriptors: *Alabama, *Legislation, *Sewerage, Sewage disposal, Cesspools, Septic tanks, Sewers, *Cities, Drainage systems, Plumbing, Eminent domain, Surface runoff, Ditches, Sanitary engineering, Storm drains, Canals, Aqueducts, Easements, Channels.

The power to construct and maintain sewers, drainage ditches, canals, etc within and without their boundaries is given to all cities and towns of the state. This power includes the taking of private property when just compensation is first made. The city can extend its sewer system to any point within the county in which it is situated using the power of eminent domain. It can also compel a landowner to drain his land at his own expense. If the landowner does not comply the city can drain the land itself and impose a lien on the property. The city also has the power to prescribe construction standards for plumbing. It may order private or public premises to connect with the city sewer system. If the owner does not comply the city may make the connection at its own expense and impose a lien on the property. Notice must be given to the property owners before any of the above powers are exercised. Notice to non-residents shall be by publication. (Watson-Fla)
W69-01974

MICHIGAN LAWS RELATING TO WATER.
Joint Committee On Water Resources Planning, Lansing, Michigan; Legislative Service Bureau, Lansing, Michigan.

Legislative Service Bur P. No. 42, 415 pp, 1966, Michigan Laws Relating to Water, pp 1-415, 1966. 415 p.

Descriptors: *Michigan, Legislation, *Water resources management, Watershed management, *Administration, Water management (Applied), *Administrative agencies.

This is a complete compilation of all Michigan laws relating to water resources management. Some statutes, such as those on sports fishing licensing, while they do deal with water in a limited sense, were excluded. This compilation was prepared for the Michigan Legislature's Joint Legislative Committee on Water Resources Planning. Some historical notes and cross references are included. Statutes on local government, Great Lakes cooperation, drainage, the Waterways Commission, the Departments of Conservation and Public Health, water and power companies, among various others, are included.
W69-01980

PROPOSALS FOR STUDYING THE FEDERAL-STATE WATER RIGHTS PROBLEM,
Los Angeles Department of Water and Power.
Rex B. Goodcell, Jr.
Journal of the American Water Works, Vol. 55, No. 8, August 1963, pp 957-961, 3 ref, 1 appendix.

Descriptors: Water supply, *Federal-state water rights conflicts, Federal jurisdiction, Water law, Water resource development, Legal aspects, Local governments, Interagency cooperation, State governments, *Water rights, Preferences, Appropriable waters, *State jurisdiction, Legislation.
Identifiers: Federal water rights, Agency bill, Desert Land Act.

If the claims of those supporting the federal view are sustained, and water originating on federal lands which constitute the major watersheds of the western states is owned and under the control of the federal government, then most of the so-called existing water rights and the water rights under state laws to appropriate and develop unappropriated waters will be subordinate to federal development and use of water. As long as there are legal questions as to water rights, such questions will result in costly litigation, and needed water development by local, state, and federal authorities will be unnecessarily burdened. If needed water development is to proceed there must be maximum cooperation between federal, state, and local water interest. There must be a clarification of states rights over federal rights; and the provision for existing water rights under state laws and protection of recognition of state law to develop water for beneficial use. (Gargola-Chicago)
W69-01981

ALLIANCE FOR CONSERVATION OF NATURAL RESOURCES IN PINELLAS COUNTY V FUREN (APPEALING DECISION OF NAVIGATION AUTHORITY ALLOWING FILL OF PORTION OF BAY).

110 So 2d 55-68 (1959) 14 p.

Descriptors: Judicial decisions, *Florida, Conservation, *Administrative agencies, Natural resources, Navigation, Water control, Bays, *Landfills, Bulkheads.

This case is in the district court on appeal from a decision of the circuit court affirming the issuance of a permit by the County Water and Navigation Control Authority for the fill of a portion of Boca Ciega Bay in Pinellas County. The district court affirmed on the same ground, i.e. that the authority was given wide discretion in the issuance of permits and if there is substantial evidence to support the decision it will not be changed. The authority's discretion will not be limited unless there is an abuse of this discretion. There was substantial evidence to support the findings of the county water and navigation control authority with respect to the beneficial effect of issuing the permit to fill a portion of the bay. (Watson-Fla)
W69-01990

CULLEY V PEARL RIVER INDUS COMM'N (CONSTITUTIONALITY OF CONSTRUCTION OF LARGE DAM AND RESERVOIR).
108 So 2d 390-409 (Miss 1959). 20 p.

Descriptors: Judicial decisions, *Mississippi, *Reservoirs, Watersheds (Basins), *Dams, Rivers, Water supply, Water districts, Riparian land, Condemnation, Eminent domain, Recreation facilities, Legislation, Navigable waters, Tidal waters.
Identifiers: Constitutional law.

Some residents of the area affected brought suit to declare the act creating the Pearl River Valley Water Supply District unconstitutional. The purpose of the act was the construction of a large dam and reservoir covering lands in parts of 5 counties. The Supreme Court of Miss upheld the act. The court stated that because the chancery court was empowered to determine if the project was feasible and would meet a public need, the act was not unconstitutional as conferring on the judiciary authority to decide legislative questions. Also the act did not violate constitutional prohibition against the legislature's passage of local, private, or special laws. Constitutional provision prohibiting the legislature from authorizing permanent obstruction of any navigable waters of the state must be construed in accordance with the meaning of the phrase 'navigable waters' at the time the constitution was adopted. It was then well established that a river was navigable in the technical sense as high up from its mouth as the tide flowed. Statutory definition of navigable waters does not effect the meaning in the constitution, and what constitutes navigable waters is a question of local and not federal law. (Watson-Fla)
W69-01991

DUVAL V THOMAS (RIGHT TO REASONABLE USE OF LAKE SURFACE).

107 So 2d 148-153 (2 DCA Fla 1968).

Descriptors: *Ownership of beds, *Riparian rights, Riparian land, *Water rights, Water utilization, Non-navigable waters, Lakes, Recreation, Reasonable use, Remedies, Landfills, Water law, Legal aspects, Boundaries (Property), Beds, *Florida.

The plaintiff and the two defendants owned property adjacent to and partially covered by a small lake. Defendant A filled a portion of the lake covering his property and defendant B erected a fence in the lake along his property line. These actions effectively cut off the plaintiff's ingress and egress to the main body of the lake. The question presented is whether the owner of a portion of the bed of a non-navigable land locked lake has the right to exercise

exclusive dominion and control over that portion of the bed and the waters of the lake which he owns. The court decided that the landowner only has the right to make reasonable use of the land and water and when ones lawful use is unreasonably interfered with, the owner of riparian rights has the remedy of injunction. The defendant's use was held to be an unreasonable interference in this instance and the plaintiff was entitled to an injunction to protect his riparian rights. (Horner-Fla)
W69-01992

ANDERSON V U S (CLAIM FOR DAMAGES TO FARM LANDS ALLEGEDLY CAUSED BY ESTABLISHMENT OF WILDLIFE REFUGES).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01993

JONES V UNITED STATES (RUNOFF DAMAGE).
175 F Supp 182-184 (Ct Cl 1959).

Descriptors: Judicial decisions, United States, *Alleviation of flow, Overflow, Flood damage, Embankments, Culverts, Drainage, Erosion, Topsoil, Surface water, Streams, Rivers, Runoff, Rainfall, *Mississippi.

Plaintiff alleges that the construction of a road on a 6 foot embankment and the installation of culverts beneath this embankment diverted the natural flow of the surface water and resulted in the inundation and erosion damage to his cultivated field. Although plaintiff was unable to prove that the culvert location changed the course or increased the natural drainage, it was shown that the use of culverts concentrated the surface water so that it emptied onto plaintiff's land at one point rather than many. This resulted in a discharge of water at a higher velocity than before and caused the erosion of topsoil and the water to stand at a greater depth. Judgment was for the plaintiff. (Childs-Fla)
W69-01994

ATTORAM REALTY CORP V TOWN AND COUNTRY BUILDERS, INC (DAMAGE FROM DISCHARGING SURFACE WATERS).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01995

RUSKIN BROS, INC V STATE (DEBRIS BLOCKAGE OF CATCHBASIN).
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-01996

GAGNER V CARLSON (RIGHTS APPURTENANT TO FLOWAGE EASEMENT).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01997

LEATHERSICH V NEW YORK STATE WATER RESOURCES COMM'N (ADMINISTRATIVE DECISIONS).
293 NYS 2d 787-791 (Sup Ct 1968).

Descriptors: *New York, *Administrative agencies, Legislation, Ownership of beds, *Land fills, Recreation, Fishing, Lakes, Riparian land, Water law, Legal aspects, Administrative decisions.
Identifiers: Evidence.

The petitioner, representing a sportsmens association sought to reverse the decision of the water resources commission allowing landowner to fill a portion of a lake bed. The petitioner contended that the decisions of the commission made pursuant to a hearing must be supported by substantial evidence. The court upheld the commission's decision because it was not arbitrary or capricious and substantial evidence was not necessary. (Horner-Fla)
W69-01998

CROLEY V DE WITT (OBSTRUCTION OF DRAIN).

431 S W 2d 657-660 (Ct App Mo 1968).

Descriptors: *Artificial watercourses, *Watercourses (Legal), *Drains, *Obstruction to flow, Natural flow doctrine, Repulsion (Legal aspects), Dams, Floods, Flooding, Riparian rights, Channels, Water law, Legal aspects.

The defendant blocked an artificial channel which caused the plaintiff's land to be flooded. The Plaintiff sought to restrain the defendants' blocking of the drain. The defendant contended that since the drain was artificial it could be blocked under the common enemy doctrine. The court rejected the doctrine and held that the defendant could not obstruct the drain, whether natural or artificial, to the plaintiff's detriment. (Horner-Fla)
W69-01999

FARNES V LANE (EASEMENT TO LAKE).
161 N W 2d 297-301 (Minn 1968).

Descriptors: *Easements, *Riparian rights, Riparian land, Real property, Right-of-way, Lake shores, Lakes, Land use, Land tenure, Docks, Piers, Water law, Legal aspects, *Minnesota.

The defendants had a right of way easement across the plaintiff's lakeshore property. The plaintiff sought a declaration that the easement was for access to the lake only and that the defendant could not build a dock or store personal property on the easement area. The court held that the plaintiff had the burden of proving the use of the easement to be improper. Riparian rights are incident to an estate in land and an easement is not an estate so riparian rights are not necessarily inherent in an easement. The case was remanded to the trial court for a determination of whether the grantor of the casement intended to give riparian rights. (Horner-Fla)
W69-02000

NORTH DADE WATER CO V ADKEN LAND CO (INJUNCTIVE RELIEF FROM DRAINING OF EFFLUENTS INTO PRIVATE LAKES).
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01948

6F. Nonstructural Alternatives

KRUPA V FARMINGTON RIVER POWER CO (FLOODING BELOW DAM).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01927

PLAN FOR FLOOD DAMAGE AT BRISTOL, TENNESSEE-VIRGINIA,
Flood Study Committee, Bristol, Tennessee, Bristol, Virginia.
Clarence B. Kearfott, Jr., Maurice Conn, and Richard C. Horner, Jr.
1962, 4 tab, 9 plates.

Descriptors: *Flood plain management, Channel improvement, Flood damage, Flood plain zoning, Non-structural alternatives, Levees, Flood protection, Historic flood, Maximum probable flood, *Detention reservoirs, *Local governments, Project purposes, Land use, Regional floods.
Identifiers: Bristol (Tennessee), Bristol (Virginia), Mumford Creek, Beaver Creek.

Outlined is a possible flood control program for Bristol, Tennessee-Virginia. A review of past flooding, with reference to magnitude and frequency is given. Evacuation of the flood plain, levees, creek diversion, and diversion tunnels are considered as possible alternatives but rejected for various reasons. The conclusion and recommendations suggest construction of two detention reservoirs and channel enlargement. Other aspects of flood management are also considered. Relation of urban renewal projects to the overall flood damage prevention program is considered and particular possibilities listed. Criteria for regulations for flood plain zoning are discussed and a model ordinance presented. An extensive discussion of possible flood proofing alternatives is put forth and recommendations for assistance to individual property owners given. The proposed reservoir project is analyzed, and the cost-benefit ratio shown to be favorable. (Gargola-Chicago)
W69-01979

07. RESOURCES DATA

7A. Network Design

THE USE OF A SQUARE GRID SYSTEM FOR COMPUTER ESTIMATION OF PRECIPITATION, TEMPERATURE, AND RUNOFF,
Shawinigan Engineering Co., Ltd., Montreal, Quebec, Canada, and James F. MacLaren, Ltd., Montreal, Quebec, Canada.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-01607

A SYSTEM FOR MEASURING CONDUCTIVITY, ACIDITY, AND RATE OF WATER FLOW IN A FOREST SOIL,
Washington Univ., Seattle.
Dale W. Cole.
Water Resources Res, Vol 4, No 5, pp 1127-1136, Oct 1968. 10 p, 10 fig, 13 ref.

Descriptors: *Network design, *Data processing, *Lysimeters, *Hydrologic data, *Soil water, Soil chemistry, Soil water movement, Computers, Washington.
Identifiers: Seattle (Washington), Tension lysimeters.

A system for collecting, recording, and analyzing forest soil water movement and quality data is described. The system is in operation on a lower terrace of the Cedar River watershed of the City of Seattle water supply. Tension lysimeters, consisting of fused aluminum oxide disks 11 in. in diameter are installed so that overlying soil and root systems are not disturbed. The collected water passes through flow cells which measure conductivity, acidity, and flow rate. The flow rate cell is sensitive to rates as low as 0.002 cm/hr. The collected data are automatically punched on paper tape and converted to tabular and graphic form in a computer. Examples of the system's output are presented. A flow diagram of the computer program is included. The data collected are particularly useful in studying ionic transport in soil to aid in understanding soil development, mineral-plant relationships, and land management practices. (Knapp-USGS)
W69-01643

7B. Data Acquisition

INFLUENCE OF THE PHYSICAL AND CHEMICAL PROPERTIES OF SOIL ON MEASUREMENTS OF WATER CONTENT USING NEUTRON PROBES,
For primary bibliographic entry see Field 02G.
For abstract, see .
W69-01616

THE STEADY-STATE MEASUREMENT OF THE RELATION BETWEEN HYDRAULIC CONDUCTIVITY AND MOISTURE CONTENT IN SOILS,
Sydney Univ., N. S. W., Australia.
D. E. Smiles, and G. D. Towner.
Water Resources Res, Vol 4, No 5, pp 1029-1030, Oct 1968. 2 p, 3 ref.

Descriptors: *Soil moisture, *Hydraulic conductivity, *Mathematical studies, Darcys law.
Identifiers: Soil moisture-hydraulic conductivity relationships.

A simple mathematical method is proposed to use with steady state head measurements to determine the relation between soil hydraulic conductivity and soil moisture content. The use of finite difference approximations to the Darcy flow equation is not necessary. The method requires the performance of a series of steady state infiltration experiments with different values of fluid flow rate and potential gradients. The simple experimental procedures to eliminate membrane impedance is suggested. (Knapp-USGS)
W69-01625

A SYSTEM FOR MEASURING CONDUCTIVITY, ACIDITY, AND RATE OF WATER FLOW IN A FOREST SOIL,
Washington Univ., Seattle.
For primary bibliographic entry see Field 07A.
For abstract, see .
W69-01643

FLUID FLOW MEASUREMENT.
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01658

MONITORING STORM-WATER OVERFLOWS,
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-01664

NEW INSTRUMENT CAN MEASURE SEWAGE FLOW,
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-01665

RESULTS OF RADAR MEASUREMENTS OF LIQUID PRECIPITATION,
A. M. Dimaksyan, and N. V. Zotimov.
Am Geophysical Union, Soviet Hydrology-Selected Papers, No 6, pp 530-7, 1965.

Descriptors: *Rainfall intensity.
Identifiers: *Radar measurement.

Correlations exist between strength of radio echo signals and rate of precipitation; confirmation is given that differential calibration of radar installation makes it possible to measure intensity of rainfall irrespective of its nature during season or in different years, and that method may be applied to any type of radar station; curve of sensitivity of radar installation in relation to characteristics of rainfall is given.
W69-01666

TEMPORARY FLOW MEASUREMENT IN SEWERS AND DRAINS,
M. H. Diskin.
ASCE Proc, J of Hydr Div, Vol 89, No HY4, Part 1, July 1963.

Descriptors: *Flow measurement, *Sewers, *Discharge measurement, Instrumentation.

Temporary flow measurement in circular channels, such as sewers and drains, as well as in sewers of other cross sections, can be carried out by introducing into the flow a pier-shaped element with a bottom rounded to fit the circular invert of the channel. The reduction in the area of flow causes a critical section to develop in the throat so formed, which gives a functional relationship between the discharge and the critical depth at the throat and also between the discharge and the depth at an upstream section adopted as a measuring section. The device is, in effect, a critical depth flume, or a Venturi flume, with an irregularly shaped throat composed of 2 openings on either side of the element introduced. Applying the theory of critical depth flumes, equations are derived relating the discharge to depth at the measuring section; the equations are solved numerically, making use of standard tables of properties of parts of a circle. The results of experiments performed on the proposed measuring device indicate fairly close agreement between the measured and the calculated rates of flow, most values of the coefficient of discharge falling in the range of 0.90 to 1.00. The experiments included tests on 4 measuring devices, 2 in each of 2 circular channels 10 in. and 16 in. diameter.
W69-01667

A FIELD METHOD OF MEASURING AND RECORDING FLOW IN SEWERS,
Warren Ellis, and C. Thorne Johnston.
Pub Works, Vol 94, June 1963.

Descriptors: *Sewers, *Flow measurement, Manholes, *Velocity, Roughness (Hydraulic), *Instrumentation.

A method of measuring and recording flow in sewers is given as follows. Determine the size, length, and slope of a sewer between 2 manholes. For known depths of flow in this sewer determine velocities between the upper and lower manholes by using dye test and stop watch. From the velocity data determine roughness coefficient 'n' through the Manning formula. Prepare a depth-discharge curve for the particular stretch of sewer. Using a stage recorder, continuously record the depth of flow in the sewer for desired period, and convert the depth data to flow rate. A portable, spring-wound stage recorder is used. A special ring to hold a bubbler tube with the tube opening at the sewer invert is mounted inside the sewer. Nitrogen gas from a bottle is bubbled through the tube, and the gas pressure required to discharge the gas beneath the liquid is recorded as depth of flow on the recorder chart. The special equipment used is described and illustrated. Costs of equipment are listed.
W69-01668

REPORT OF U. S. WEATHER BUREAU STUDIES IN RADAR HYDROLOGY,
A. F. Flanders.
Int Geodetic and Geophysical Union-Sec for Sci Hydrology Publ No 65, pp 360-71, 1964.

Descriptors: *Rain gages, Instrumentation.
Identifiers: *Radar measurement.

Progress made by U S Weather Bureau on measurement of precipitation by WSR-57 radar is presented; various operational attempts, techniques and applications made in field of radar-hydrology show successes and limitations encountered as well as progress made with Radar Precipitation Integrator; plans for utilization of radar as continuous recording rain gage as step toward automation in radar-hydrology-computer area.
W69-01671

ADJUSTMENT OF RADAR ESTIMATES OF STORM MEAN RAINFALL WITH RAIN GAGE DATA,
For primary bibliographic entry see Field 02B.
For abstract, see .
W69-01673

DISPOSAL OF MUNICIPAL SEWAGE (WATER POLLUTION CONTROL AND ABATEMENT).
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01724

REMOTE CONTROL GROUTING OF SEWER LINE LEAKS,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01748

PING-PONG BALLS WILL TRACE POLLUTION.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01762

ECONOMICS OF URBAN DRAINAGE DESIGN,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01771

A METHOD OF COMPUTING URBAN RUNOFF,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01884

PROGRESS REPORT (STUDY OF RATIONAL METHOD),
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01894

ANALYSES AND APPLICATION OF SIMPLE HYDROGRAPHS,
H. N. Holtan, and D. E. Overton.
J Hydrology, Vol 1, No 3, pp 250-64, 1963.

Descriptors: *Hydrographs, *Watersheds, *Rainfall intensity, Storms.

Method of hydrograph analyses to derive parameters for computing hydrographs tailored to specific watersheds and specific rainstorms; simple hydrographs are analyzed to develop techniques for rapid derivation of watershed storage coefficient, and subsequently, for defining and positioning hydrograph in terms of storage coefficient and rainfall intensity period; simple hydrographs are developed by these techniques for storm increments or for homogeneous increments of heterogeneous watersheds, and summated to derive complex, multiple-peak, or sustained-flow hydrographs.
W69-01913

MEASURING RAINFALL AND RUN-OFF AT ATORM-WATER INLETS,
J. W. Knapp, J. C. Schaake, and W. Viessman.
ASCE Proc, J of Hydr Div, Vol 89, No HY5, p 99, 1963.

Descriptors: *Rainfall-runoff relationships, *Rain gages, Intakes, Instrumentation, *Automatic control, Storms, *Runoff, *Storm runoff.
Identifiers: *Urban drainage.

An illustrated description is given of an instrument system which has been developed to measure rainfall and run-off in small urban drainage areas draining to storm-water inlets. The system includes a rain gauge on each area, a measuring device inside the inlets, a recorder, and controls providing automatic operation during storms. The installation can be completed with few alterations to existing drainage facilities.
W69-01923

7C. Evaluation, Processing AND Publication

GEOLOGIC FACTORS IN COMMUNITY DEVELOPMENT AT NAPERVILLE, ILLINOIS,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-01594

THE USE OF A SQUARE GRID SYSTEM FOR COMPUTER ESTIMATION OF PRECIPITATION, TEMPERATURE, AND RUNOFF,
Shawinigan Engineering Co., Ltd., Montreal, Quebec, Canada, and James F. MacLaren, Ltd., Montreal, Quebec, Canada.
S. I. Solomon, J. P. Denouvilliez, and E. J. Chart.
Water Resources Res, Vol 4, No 5, pp 919-929, Oct 1968. 11 p, 5 fig, 2 tab, 5 ref.

Descriptors: *Data processing, *Digital computers, *Networks, Data storage and retrieval, Data transmission, Meteorological data, Hydrologic data, Synoptic analysis.
Identifiers: *Drainage basin characteristics, Newfoundland, Square grid data matrices.

Water resource studies in recent years have had a tendency to encompass larger areas. The increase in size and sophistication of these studies makes the use of computers very desirable to save time and increase accuracy. The study area must be converted to a schematic representation which is easily manageable by computers. A simple way of doing this is to cover the study area with a square grid, which may then be treated as a matrix of squares. This system can be used to store, process, and retrieve information in the fields of hydrology, hydraulic power, and economics. The application of the square grid system to the estimation of the precipitation, temperature, and runoff distribution in a large area is demonstrated. Use of the system enables efficient combination of the meteorologic and hydrologic information available in studying the precipitation, temperature and runoff distribution. An example of such a computation for a 43,000-square-mile area is given and the advantages of the method over the usual techniques are discussed. (Knapp-USGS)
W69-01607

UNIFORM FLOOD-FREQUENCY ESTIMATING METHODS FOR FEDERAL AGENCIES,
U S Geological Survey, Washington, D. C.
Manuel A. Benson.
Water Resources Res, Vol 4, No 5, pp 891-908, Oct 1968. 18 p, 1 fig, 6 tab, 5 ref.

Descriptors: *Floods, *Statistical methods, *Frequency analysis, Data processing, Flood protection, Rivers.
Identifiers: *Flood frequencies, Flood-plain management, Log-Pearson Type III method.

Large-scale planning for improved flood-plain management and expanding water-resources development makes increasingly important a consistent approach to estimation of flood frequencies. The most commonly used methods of flood-frequency analysis were studied and the results of applying these methods to a selected group of long-record representative sites in different parts of the country were compared. It is recommended that all government agencies adopt a uniform procedure for flood-frequency analysis at sites where records are available. The log-Pearson Type III distribution was selected as the basic method, with provisions for departures if justified. Further study leading toward improvement or revision of methods is recommended. (Knapp-USGS)
W69-01609

GEOPHYSICAL LOG CROSS-SECTION NETWORK OF THE CRETACEOUS SEDIMENTS OF SOUTHERN MARYLAND,
U. S. Geol Surv., Washington, D. C., Water Resources Div.
Harry J. Hansen, III.
Maryland Geol Surv Rep of Invest No 7, 46 p, 1968. Test, 8 fig, 17 plate, 7 tab, 1 append, 67 ref.

Descriptors: *Stratigraphy, *Hydrogeology, *Electrical well logging, *Radioactive well logging, *Cross-sections, Geologic formations, Palynology, Sampling, Maryland.
Identifiers: Southern Maryland, Stratigraphy, Holes.

Cross sections and maps were prepared, using electric logs, gamma-ray logs, and published stratigraphic data for groundwater oriented studies in Southern Maryland. The correlation network consists of 4 cross sections subparallel to the strike of the Cretaceous formations and 12 cross sections subparallel to the dip. Correlation is based on geophysical (electric and gamma ray logs) and lithological data; selected well samples were studied palynologically. This network suggests that groups of sands, such as those comprising the Patuxent Formation, can be correlated along strike in the Anne Arundel-Prince Georges County area for distances exceeding 20 miles. This is not compatible with a concept of individually isolated, channel or 'shoestring' sands. Sand counts indicate that both the Patuxent and the Raritan-Patapsco Formation (undivided) exhibit a southerly decrease in sand percentage. In the Anne Arundel-northern Prince Georges County area these formations contain greater than 45% sand; in Charles County sand percentages characteristically are less than 30%. The mottled clays associated with these sediments change form predominantly red-brown in the north to predominantly gray-green in the south. (Knapp-USGS)
W69-01638

THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL CONDITIONS,
Vanderbilt Univ., Nashville, Tenn; Office of the Surgeon, Headquarters, U. S. Army Vietnam; and Johns Hopkins Univ., Baltimore, Maryland.
For primary bibliographic entry see Field 02D.
For abstract, see .
W69-01642

APPLICATION OF THE DIGITAL COMPUTER FOR AQUIFER EVALUATION,
Nova Scotia Department of Mines, Halifax, and U. S. Geological Survey.
George F. Pinder, and J. D. Bredehoeft.
Water Resources Res, Vol 4, No 5, pp 1069-1093, Oct 1968. 25 p, 18 fig, 53 ref.

Descriptors: *Computer models, *Digital computers, *Computer programs, *Unsteady flow, *Aquifers, Aquicludes, Analog models, Pump testing, Aquifers characteristics, Hydrogeology, Water levels.
Identifiers: Finite difference method, Pumping tests.

A digital computer program was written to solve linear, parabolic, partial differential equations of unsteady state flow in confined aquifers by an implicit finite difference technique. The program was checked by calculating solutions for problems described by known analytical functions and solved by electrical analog. The calculated and analytical values compared favorably. An aquifer at Musquodoboit Harbour, Nova Scotia was analyzed; aquifer parameters in the digital model were modified to fit computed results to pump-test data. The results were compared to an electric analog solution and the results were in good agreement. (Knapp-USGS)
W69-01646

THE INTERNAL DISTRIBUTION OF ANALYSIS VALUES AS AN INDICATOR OF EUTROPHICATION,
Michigan Univ., Ann Arbor, Great Lakes Res Div, Inst of Science and Tech.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-01650

PROGRESS REPORT OF THE STORM DRAINAGE RESEARCH PROJECT.
Johns Hopkins Univ., Baltimore, Md. Dept. Sanit. Eng. and Water Resources.
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-01659

COMPUTERS TO CONTROL COMBINED SEWERS.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01716

STORM SEWER DESIGN AND ANALYSIS BY COMPUTER.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01757

SURFACE WATER DRAINAGE CALCULATION BY DIGITAL COMPUTER,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01782

HOW TO ESTIMATE STORM WATER QUANTITIES,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01785

THREE-DIMENSIONAL TYPE REPRESENTATION OF HYDROLOGICAL DATA,
A. A. Hirsch.
AWWA-J, Vol 56, No 7, p 937, July 1964.

Descriptors: *Rainfall-runoff relationships, *Data collections.

Three-dimensional method of presenting time-related values for data related to rainfall, streamflows, water levels, etc, so that 1-yr graphs can be compared over periods of many years; method whereby yearly curves are cut-out, laminated in clear plastic, and mounted in plots on baseboard, for furnishing easily comprehensible volume of data in compressed form.
W69-01912

RAINSTORMS MADE TO ORDER,
L. Arthur Hoyt.
Pub Works, Vol 99, No 3, pp 95-98, March 1968. 4 p, 1 fig, 2 photo.

Descriptors: *Computer programs, *Storms, *Rainfall intensity, Watersheds, *Storm runoff.

A computer controlled rainfall simulator has been developed by Ven Te Chow of the University of Illinois to produce artificial rainstorms. The simulator can develop storms of any intensity pattern, repeat them at any interval desired over all types of terrain, and measure runoff from the terrain with given conditions of absorption and other parameters, to an accuracy never before obtainable. The rainfall can be released over any part, or all, of a 40- by 40-ft artificial terrain. Types of storms are programmed and stored on computer tape so they can be started, stopped, or repeated at will. The terrain simulated can range from lush water basin areas to arid desert. Water runoff is accurately measured. Major objective of the entire study is to

investigate basic laws of flow mechanics of surface water over artificial watersheds. Descriptions of the electronic simulator and operation of major components are given.
W69-01914

DISSIPATIVE RIVER FLOW MODEL,
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-01917

CALCULATION OF DISCHARGE OF RAIN DITCHES AND RAINFALL COLLECTING SYSTEMS,
G. Jeuffroy, and J. Prunieras.
Construction, Vol 19, No 1, pp 21-9, Jan 1964.

Descriptors: *Discharge (Water), *Storm drains, Rivers, Runoff forecasting.
Identifiers: *Calculations.

Calculation of discharge of rain ditches and rainfall collecting systems; method for calculating maximal flow of ditch or surface channel bordering elongated area, taking into account local meteorological factors and discharge rate of drainage system; variable discharge rate is stated by equation with partial derivatives where integration provides simple solution for flow at arbitrary time and point; theory applicable to flood levels on rivers.
W69-01918

LINEAR ANALYSIS OF RAINFALL-RUNOFF RELATIONSHIP,
V. C. Kulandaiswamy.
Instn Engrs (India)-J, Vol 46, No 11, pt Ci 6, pp 594-603, July 1966.

Descriptors: *Rainfall-runoff relationships, *Hydrographs.
Identifiers: *Calculations.

Study of relationship between rainfall excess and surface runoff by treating rainfall excess as 'inflow to' and surface runoff as 'outflow from' basin, and assuming relationship to be linear; using Laplace transform method, expression is derived for instantaneous unit hydrograph; various assumptions underlying existing instantaneous unit hydrograph theories and approximations made in their development are explained.
W69-01924

A BASIC STUDY OF THE RAINFALL EXCESS-SURFACE RUN-OFF RELATIONSHIP IN A BASIN SYSTEM,
V. C. Kulandaiswamy.
Thesis, Univ of Illinois, 1964.

Descriptors: *Rainfall-runoff relationships, *Hydrographs, Drainage, Storms, *Surface runoff.
Identifiers: *Calculations.

After reviewing various instantaneous unit hydrograph theories, the author develops a general theory for the relation between rainfall and run-off in a drainage basin. An equation is first derived for storage in the basin, and this equation is then combined with the equation of continuity to give the differential equation for the system. The theory is valid for both linear and non-linear cases. Storms over 6 natural basins were analysed to verify the theory; the storage and surface run-off computed agreed well with observed values.
W69-01925

EXTENDED TABLES OF THE TRANSFORMATION (PHI = (2) (ARCSIN SQUARE ROOT X)),
Canada Fisheries Research Board, Nanaimo, British Columbia.
J. R. Dryburgh, J. A. Thomson, and D. F. Alderdice.
Tech Rept 45 Dec 1967. 23 p.

Descriptors: *Data processing, *Statistics, Computers, Bioassay.
Identifiers: *Arcsin transformation, *Angular transformation, Variance stabilization, Tables.

Authors present tables of computer-generated values to four significant decimals of the transformation, Phi = (2) (arcsin square rootX), for arguments of X from 0.0001 to 0.9999 in increments of 0.0001. The transformation has been commonly used to stabilize variance of data presented in the form of proportions, as in some bioassay trials. (Wis)
W69-01975

08. ENGINEERING WORKS

8A. Structures

HYDRAULIC DESIGN OF STORM SEWAGE OVERFLOWS INCORPORATING STORAGE,
P. Ackers, A. J. M. Harrison, and A. J. Brewer.
Instn Mun Engrs J, Vol 95, No 1, pp 31-7, Jan 1968.

Descriptors: *Overflow, *Hydraulic design, Weirs, Storm runoff.
Identifiers: *Storage tank, Capacity.

Consequences of designing storm overflows to spill all discharges over set value, regardless of dynamic behavior of storm flow, are considered; it is concluded that it is desirable to avoid spilling first part of storm wave and method of calculating its volume is presented; necessary volume of storage tank to contain flush downstream of overflow weirs is considered; equations describing rate of rise of level in tanks of rectangular and circular cross-sections are solved for case of uniformly increasing rate of inflow within range of overflow settings; design example is given on calculation of volume of tank for overflow.
W69-01678

PRELIMINARY GUIDANCE FOR THE CALCULATION AND DESIGN OF STORM-SEWAGE OVERFLOWS IN COMBINED SEWAGE SYSTEMS.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01682

KENT SEWERAGE WORKS FOR 9000 PEOPLE.

Munic Eng, Lond, Vol 142, p 1803, 1965.

Descriptors: Overflow, Storm runoff.
Identifiers: *Storage tanks.

A description with plan is given of improvements planned by Eastry R.D.C., Kent, to the sewerage system for St. Nicholas-at-Wade, Monkton and Minster. The existing treatment plant at Minster, which provides complete treatment by biological filtration, is to be enlarged to deal with a dry-weather flow of about 300,000 gal per day. Storm-water tanks will receive flows of from three to six times the dry-weather flow.
W69-01683

SKIPTON-SILSDEN SEWERAGE FINISHED AHEAD OF SCHEDULE.

Munic Eng, Lond, Vol 140, p 1344, 1963.

Descriptors: *Storm runoff, *Overflow, Sedimentation, Weirs.
Identifiers: Storage tanks.

In a recently completed joint sewerage scheme for Skipton rural district and Silsden urban district, Yorks., all the sewage from the area will be conveyed to the Keighley disposal works by an extension of the Keighley sewers up the Aire valley. Six small sewage works will be abandoned, but at Silsden and Stelton storm water will overflow to sedimentation tanks at the old works before discharge to the river Aire. There are also five overflow weirs on existing sewers with direct discharges to the nearest watercourse. A pumping station on the site of the Kildwick works will pump sewage from Farnhill and Kildwick across the river Aire by a rising main to join the main sewer.
W69-01684

NEWTHORPE, NOTTS., SEWAGE DISPOSAL WORKS.

Survr Munic Cty Engr, Vol 130, No 3923, pp 18-19, 55, 1967.

Descriptors: *Storm runoff, Overflow.
Identifiers: *Storage tanks.

A description, with a flow diagram of treatment facilities and a map of the sewerage area involved, is given of new works to be constructed jointly by Basford R.D.C. and Eastwood U.D.C., Notts. A new sewage works at Newthorpe, designed to treat a flow of 18 m.g.d. by biological filtration with recirculation of effluent, will replace 7 existing works; flows in excess of 18 m.g.d. will pass to 3 storm-water tanks. Primary sludge will be treated by Paxman sludge concentrator units, and humus sludge will be returned to the main inlet.
W69-01685

STORM WATER OVERFLOWS. THE USE OF SIPHONS AT IPSWICH,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01692

DESIGN OF UNDERWATER STORM WATER OVERFLOW STORAGE SYSTEM,
J. S. Blossom.
Piping and Air Condit, Vol 40, No 4, pp 126-30, April 1968.

Descriptors: *Design, *Storm runoff, *Overflow, Runoff, Outlets, *Flow measurement, *Instrumentation.
Identifiers: *Storage tanks, *Combined sewers, *Interceptor sewers, *Suspended solids, *Capacity.

Sequence of operation of underwater storm water overflow storage system using flexible tanks is described; combined sewer carries runoff from drainage area; dry weather flow connection carries normal sanitary flow to interceptor, and overflow sewer carries storm water to river outfall; diversion structure of sewer diverts flow to storage system; incorporated in structure is flume to measure flow; suspended solids analysis of overflow; capacity analysis of underwater storm water overflow storage system, based on 11 yr of rainfall data.
W69-01693

DRAW-DOWN AND OTHER FACTORS RELATING TO DESIGN OF STORM-WATER OVERFLOWS ON SEWERS,
C. D. C. Braine.
J Instn Civ Eng, Vol 28, No 6, pp 136-63, April 1947.

Descriptors: *Storm runoff, *Overflow, Sewers, *Siphons, *Stilling basins, *Drawdown, Design.

Calculations for critical depth and draw-down; description of storm water overflows of restricted flow; stilling pond and siphon types.
W69-01695

HYDRAULIC DESIGN OF DEPRESSED CURB-OPENING INLETS,
W. J. Bauer, and D. C. Woo.
Nat Res Council-Highway Res Bd-Res Rec, No 58, pp 61-80, 1964.

Descriptors: *Hydraulic design, *Intakes, *Highways, Drainage systems, *Storm runoff.

New hydraulic design curves for depressed curb-opening inlets used in highway drainage systems were developed from experimental data; curves cover considerable range of practical conditions and also allow direct comparison of effect of size of depression to efficiency of inlet; sump condition is included that refers to condition that inlet is located at low point of sag vertical curve; application of curves is presented.
W69-01702

DESIGN, CONSTRUCTION AND OPERATION OF SEWER OUTFALLS IN ESTUARINE AND TIDAL WATERS,
Frank L. Heaney.
Water Poll Control Fed J, Vol 32, No 6, pp 610-21, June 1960.

Descriptors: *Estuaries, Design, Construction, *Outlets, Sewers, Standards, Chlorination, *Rainfall intensity, *Overflow, *Water pollution, *Hydraulics, Maintenance.
Identifiers: *Combined sewers, *New York, N. Y., *Urban drainage.

The object of design of outfall sewers was to destroy the physical character of the sewage without objectionable odors, floating solids at shore line, scum accumulations or bottom deposits. Present day standards require, in addition, a reduction of bacterial concentration. In discussing design the author states that shore overflows from plant should be avoided and provisions should be made for emergency chlorination. In New York City experience has shown that 0.02 in/hr rainfall has resulted in discharge of approximately 30% raw sewage from combined sewer overflows. Also that from 70 years of records, one to two rainstorms of over 0.02 inch/hour occur each week during the summer. The receiving waters remain polluted for a period of one to three days after each rainfall. Author discusses location of outfalls, hydraulic considerations, and design of outlet structures. In design the author uses the charts and formulas of Rown and Palmer and shows the theoretical computations of mixing of sewage with sea water. Each area must have tests taken to assess the effectiveness of mixing. The author discusses construction and maintenance of outfall sewers and also costs of same.
W69-01703

STORM WATER TANKS WITHOUT GRADIENTS, A METHOD OF IMPROVING THE SEWERAGE SYSTEMS OF TOWNS,
F. Schimrick.
Gas Wasserfach, Vol 92, pp 156-8, 1951.

Descriptors: *Storm runoff, Design, Pumping.
Identifiers: *Storage tanks, *Urban drainage.

The author discusses the possibility of inserting storm water tanks in sewerage systems. Where the depth of the tank is somewhat less than the internal diameter of the inlet channel, no gradient is necessary. The use of such inserted tanks to reduce the load on pumping plant and sewage works is discussed with examples of their effect in various towns.
W69-01708

DEEP TUNNEL SYSTEM GETS OFF THE GROUND.

ASCE - San Eng Div, Newsletter, pp 7-8, May 1967.

Descriptors: *Tunnels, *Grants, *Sewage lagoons, *Floor control, Instrumentation, *Overflow, Pumping, *Sewage sludge.
Identifiers: *Combined sewers, Chicago (Ill.), *Storage tanks, New York (N. Y.).

Chicago has received a $1 million grant from FWPCA to help build and demonstrate a $14,389,600 deep-tunnel system to store the rain-swollen flows in combined sewers in part of the city's northside. When the flow in the combined sewers returns to normal, the water stored in the tunnel will be pumped back into the sewer lines for treatment. Other grants awarded were to: Shelbyville, Ill. to help build a system to hold and treat combined-sewer flows in several holding and treatment lagoons and a holding tank; to New York City to help pay for the installation and evaluation of a siphon-type Ponsar regulator designed to provide better control of the flows from combined sewers into interceptor sewers; and to Columbus, Ohio to help renovate and improve the efficiency of the combined-sewer overflow holding tanks by installing new pumps which will remove sludge which now accumulates and causes odors.
W69-01712

ASCE SEWER PROJECT CONTINUES.

ASCE - San Eng Div, Newsletter, p 5, Jan 1967.

Descriptors: *Pumping, *Equipment, Drainage system.
Identifiers: *Sewer-within-sewer, *Combined sewers, *Urban drainage.

ASCE is continuing to study the sewer-within-a-sewer concept under a new contract. Combination grinder-pump units will be developed for both household and commercial uses. A limited number of these will go into buildings in a demonstration area and be connected to piping installed in existing combined sewers. Tests will be conducted for a six month period. At the same time, plans will be developed for a demonstration in an entire urban drainage area.
W69-01713

COMBINATION SEWER SEPARATED INTO SANITARY AND STORM LINES LOW COST.

Civ Eng, Vol 36, No 5, p 55, May 1966.

Descriptors: Sewers, Pipes, Tunnels.
Identifiers: *Combined sewers, Storm sewers.

Sewer department of Minneapolis, Minn., has recently placed 5700 ft of corrugated steel pipe in bottom of existing combination sewer--for sewage only, to reduce load on treatment plant; Armco Smooth-Flo pipe, 42 in. in diam has asphaltic liner; flattened to 53 x 22.5 in., it fits well into bottom of old 102-in.-diam tunnel; prefabricated bands with neoprene gaskets hold sections together, and corrugated hold-down bands anchor them to tunnel wall; concrete is then placed to prevent line from 'floating' and provide smooth base for storm flow above.
W69-01714

DATA AVAILABLE ON SEPARATING COMBINED SEWERS.

Environ Sci Technol, Vol 2, No 8, p 577, Aug 1968.

Descriptors: *Construction costs, *Overflow, *Storm runoff, Pumping.
Identifiers: *Combined sewers, *Sewer separation, *Storm sewers, *Storage tanks, *Washington, D. C.

The cost of separating the combined storm and sanitary sewers in the United States, which now serve 36 million people, is approximately $48 billion, according to a recent report prepared by the American Public Works Association for the Federal Water Pollution Control Administration. The report is a national inventory of the effects and means of correcting combined sewer overflows and separate storm and sanitary sewer discharges in the United States. A pilot project to construct two giant rubberized tanks in the Anacostia River in Washington, D. C. to store overflow during heavy rainfall is also mentioned. Each tank has a capacity of 100,000 gallons and will be anchored in the river bed. During the period of overflow, sewage will be diverted into an on-shore pump house where it will be crushed before being pumped into the tanks. The contents of the tanks will be pumped back into the sewer lines after the storm water recedes.
W69-01715

SEWER SEPARATION.

Water and Wastes Eng, Vol 3, p 2, 1966.

Descriptors: Sewers, *Overflows, Design, *Water pollution.
Identifiers: *Combined sewers, *Sewer infiltration.

Engineers and Superintendents of Sewer systems representing a cross-section of the country were asked several questions regarding their systems. These questions included miles of different-types of sewers, if infiltration was a problem, number and types of regulators and diversions used, design of combined systems and if any bottlenecks, and an estimate of percentage and amount of pollution bypassed each year. Answers indicated that infiltration was a problem in several cities, but the sewage lost from bypassing or overflows was not a significant pollution problem.
W69-01719

SEWER WITHIN A SEWER.

Water Works and Wastes Eng, Vol 1, pp 36-37, 101, Feb 1964.

Descriptors: *Sewers, *Plastic pipes, *Construction, Construction costs.
Identifiers: *Combined sewers, *Ottawa (Canada).

Ottawa, Ont., Can., constructed small gravity sewers inside 2 existing large-diameter combined outfall sewers to convey intercepted sanitary flow to a new main interceptor tunnel. The inner sewer slopes in the opposite direction from the outer sewer, which is accomplished by starting the high end of the inner sewer at the top of the large sewer and spiraling it down the outer sewer wall. In one location because of corrosive wastes the inner sewer consists of 1440 ft. of 15 in. dia. PVC plastic pipe. In the other location the inner sewer is 1303 ft. of 12 in. CI pipe. The 15 in. sewer cost $20.41 to $24.41 per ft in place. The sewer within a sewer technique permitted main interceptor modifications that saved an estimated $1,200,000. When completed, the main interceptor system will consist of 38,300 ft of 72 in. to 96 in. dia. tunnel.
W69-01720

FACTS ABOUT COMBINED SEWER SYSTEMS.

Water and Wastes Eng, Vol 4, No 11, p 78, Nov 1967.

Descriptors: *Combined sewers.

Facts about combined sewer systems are being collected by the American Public Works Association. A $250,000 grant from the Federal Water Pollution Control Administration has been awarded to the Association, whose representatives will conduct on-site interviews with water officials of about 900 communities with combined sewer systems. All cities with populations over 25,000 will be included in the survey and checks will also be made on 30 percent of smaller communities having this type of system.
W69-01721

DRAINAGE (SEWERAGE).
C E Code of Practice No 5, Instn of Mun Engrs, London, 1950.

Descriptors: *Design, *Sewers, Manholes, *Storm runoff, *Overflow, Siphons, Pumping, *Runoff.

In a Code of Practice intended to indicate what is considered to be good practice in the design and construction of sewerage systems under average conditions, recommendations are made concerning choice of sewerage system, layout, size, shape, depth and gradient of sewers, manholes, storm-water overflows, siphons, pumping stations, pumping mains, tidal outfalls, and other works. Information is given on legislation concerning discharge of trade waste waters to sewers and on the effect of some types of trade waste waters on sewerage systems and on natural waters. In an appendix, a suggested method for calculating run-off is described.
W69-01722

INTERCEPTOR SEWERS,
E. E. Bloss.
Presented at Amer Soc of Civ Engrs Meeting, Oct 18-22, 1965, Kansas City, Missouri.

Descriptors: Design, Pumping, Treatment, *Flow measurement, Hydrographs, Overflow, Storm runoff, *Water pollution control, Hydraulics, Construction costs.
Identifiers: *Interceptor sewers, *Capacity, St. Louis (Mo.), Combined sewers, Sewer infiltration.

Subject matter discussed in this paper on interceptor sewers applies specifically to the design of the interceptor sewers of the Metropolitan St. Louis Sewer District Pollution Abatement Project. The paper includes as background information, a brief description of the District, as well as a brief description of the overall plan of the proposed interception, pumping and treatment facilities. The methods used in gaging present flows are also discussed and a number of measured sewer hydrographs are reproduced. Detailed investigation of the spill of mixed sewage and rainfall with interceptors of several different capacities is discussed in considerable detail leading to the finding that adequate abatement of pollution can be achieved with interceptors having a capacity equal to the peak rate of sewage flow. In this investigation sewage flow was considered to consist of domestic and industrial waste flow only; it did not include ground water infiltration. However, to completely avoid spill during dry weather, it was further concluded that interceptors, in final design, should have a capacity equal to the peak flow of sanitary sewage plus the peak rate of ground water infiltration. Detailed computations of sewage spill were made under conditions of present and assumed ultimate watershed development for interceptors on two of the largest sewers of the District as finally designed. Two typical interceptor structures are discussed and illustrated. Storm water flows for several assumed runoff rates and the effects of such flows on the hydraulics of the trunk interceptor sewer are discussed. Finally, in order to illustrate the disproportionate effect on cost when compared to the small improvement in pollution abatement accomplished by increasing interceptor capacities. The trunk sewer was resized to accommodate 1.25 times peak dry weather flow. A cost estimate of the trunk to carry the larger flow was prepared and compared with the estimated cost of the trunk as designed. The reduction in degree of pollution abatement which would have been achieved by the slightly larger interceptor was also computed and shown to be inconsequential. The economic inadvisability of increasing interceptor capacity beyond one times peak dry weather flow for the St. L
W69-01728

AN EVALUATION OF THE PROBLEMS OF SANITARY SEWER SYSTEM DESIGN,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01742

SEWER DESIGN-INFILTRATION DETECTION AND CORRECTION,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01744

FLOOD RELIEF PROJECT IN LONDON SUBURB.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01754

NEW SEWERAGE FOR CROYDON.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01755

BORE DUG IN WET SOIL FLOWS TRICKY PATH.

Const Methods and Equip, Vol 46, No 7, pp 140-2, 145-6, July 1964.

Descriptors: *Tunnel construction, Drilling equipment.
Identifiers: Storm sewers.

Methods used in building tunnel of storm sewer at Houston, Tex. are outlined; shallow 447-ft-long section by open-cut method at one end of job was first installed and then 6500 ft was excavated with wheel-type mining machine; tunnel passes 35 to 40 ft. under many streets, railroad tracks, and about 100 utility lines; mining wheel had to go through 15-ft-wide gaps to be bordered by freeway columns later; to control wet ground, workers relied on deep wells, air pressure, and chemical grout.
W69-01756

HIGHWAY BRIDGE MEN BUILD TUNNEL FOR WATER.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01758

STANDARDS FOR STORM-WATER FACILITIES.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01761

PROCEEDINGS OF THE THIRTEENTH CONFERENCE OF LOCAL AUTHORITY ENGINEERS, QUEENSLAND, 1962.

Queensland Dept of Local Government, Brisbane. 190 pp.

Descriptors: *Design, *Construction, *Drainage systems, *Storm runoff, Sewers.
Identifiers: *Storm sewers.

This publication contains the full text of papers and discussions presented at a conference in Brisbane, October 1962, dealing with various subjects of concern to local authority engineers, including the design, construction, and maintenance of mild-steel reservoirs; service pipes for water-distribution systems; design, construction, and maintenance of open drains (both lined and unlined), including irrigation channels; materials for sewers and methods of jointing; dewatering of wet ground, including methods for lowering the water table; and the design and construction of storm-water drainage systems.
W69-01764

A GUIDE FOR ENGINEERS TO THE DESIGN OF STORM SEWER SYSTEMS, PREFACED BY THE REPORT OF THE JOINT COMMITTEE ON RAINFALL AND RUN-OFF OF THE ROAD RESEARCH BOARD AND THE MINISTRY OF HOUSING AND LOCAL GOVERNMENT.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01766

SMALL UNDERGROUND DRAINS AND SEWERS: I AND II.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01767

STORM DRAINAGE SYSTEMS.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01769

STORM SEWER TUNNEL IN ST. PAUL,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01773

TORONTO CONFRONTS OUTDATED SEWERS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01774

RETENTION BASIN ELIMINATES NEED FOR COSTLY STORM SEWERS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01777

STORM WATER DETENTION IN URBAN AREAS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01778

DESIGN OF SURFACE-WATER SEWERS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01781

CALCULATION OF STORM-SEWAGE TANKS.
H. Fischer.
Gas Wasserfach, Vol 105, pp 543-544, 1964.

Descriptors: *Storm runoff, Design, Overflow, Discharge (Water).
Identifiers: *Storage tanks, *Calculation, *Capacity.

In connexion with the design of storm-sewage tanks for the Rheingonheim area of Ludwigshafen, investigations were carried out on the frequency of action of storm-sewage overflows, and the characteristics which should be considered when calculating the discharge after the peak load. Results showed that the characteristics of the flow record can be very variable for different periods of rain even if the maximum coefficient remains the same. The author presents graphs and a chart for a simplified calculation of discharge from storm-sewage overflows and gives a numerical example which can be adapted to any particular characteristic of discharge.
W69-01783

MAIN DRAINAGE OF LEYTON,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01786

CONSIDERATION OF STORAGE CAPACITY IN STORM-WATER SEWERS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01788

PROBLEMS IN THE PLANNING OF SEWAGE WORKS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01824

CONTRIBUTION TO THE DETERMINATION OF THE DIMENSIONS OF RAIN STORAGE TANKS,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01921

DESIGN AND OPERATION OF LOW-HEAD SELF-PRIMING SIPHONS,
C. D. C. Braine.
Survr, Vol 116, pp 1141-43, Nov 2, 1957.

Descriptors: Design, *Siphons, *Weirs, *Storm runoff, *Overflow, Sewers, Discharge (Water).

Small self-priming siphons have advantages over weirs for storm water overflows and other water level regulating uses in sewers and canals. They are as a rule cheaper than weirs provided that at least one foot of head is available. The siphon is more flexible in operation than a weir. Siphons can be made very sensitive, and by admitting air in limited quantities, their discharge can be varied considerably. Also installations of a battery of several siphons permits flexibility of discharge. Nine illustrations of siphon designs are given. Self-priming of a siphon is achieved by allowing a sheet of water to flow over the whole width of the crest so that as the sheet falls it strikes the opposite wall of the siphon. The falling sheet of water entrains air with it and carries it down to the outlet so that the siphon very quickly primes. A formula for estimating the discharge of circular siphons flowing full is given.
W69-01964

CULLEY V PEARL RIVER INDUS COMM'N (CONSTITUTIONALITY OF CONSTRUCTION OF LARGE DAM AND RESERVOIR).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-01991

8B. Hydraulics

EVALUATION OF THE EFFECT OF MINING THE IRON ORE DEPOSITS OF THE KURSK MAGNETIC ANOMALY ON THE FLOW REGIME OF THE OSKOLETS RIVER,
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-01629

SEEPAGE THROUGH AN EARTH DAM COMPUTED BY THE RELAXATION TECHNIQUE,
Stanford Univ., Stanford, California.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01641

FLUID FLOW MEASUREMENT.

Brit Patent 862,891.

Descriptors: *Flow measurement, *Pipes, *Tracers, Velocity.

A method is claimed for determining rates of fluid flow and comparing relative rates of flow under different conditions in pipes, canals, or rivers, by introducing a known quantity of radioactive material and monitoring the stream to obtain a time-integral value of the effect of the radioactivity during its passage or transit past a given point (by integrating the response of a radioactivity detector such as a Geiger counter). The method is based on the discovery that the integral or total number of gamma or other suitable radioactive rays detected is inversely proportional to the velocity of flow, but is independent of the way in which the radioactivity is spread out along a segment of the fluid stream as the result of flow conditions.
W69-01658

PROGRESS REPORT OF THE STORM DRAINAGE RESEARCH PROJECT.
Johns Hopkins Univ., Baltimore, Md. Dept. Sanit. Eng. and Water Resources.

Report No 10: July 1, 1961 to June 30, 1962 Baltimore, June 1962, 187 pp.

Descriptors: *Instrument, *Storm runoff, Rain gages, *Flow measurement, *Weirs.
Identifiers: *Storm sewers, Surface permeability.

The results of the project's effort to develop reliable rainfall and stormwater runoff measuring instruments are presented. A depth type pressure sensing device for measuring the flow at a single point in a storm sewer, and a sharp-crested sensing weir for measuring the runoff entering a stormwater inlet, have been developed. It is felt that these instruments can be employed by other agencies with very few changes. The observation of widely differing amounts of runoff from storms of the same frequency, with changes in soil permeability as a factor, is one of the other problem areas mentioned.
W69-01659

THEORETICAL CONSIDERATION OF SIDE WEIRS AS STORM WATER OVERFLOWS,
P. Ackers.
Instn Civ Engrs Proc, London, Vol 6, pp 250-69, Discussion pp 328-43, Feb 1957.

Descriptors: *Overflow, *Weirs, *Storm runoff, Spillways, Discharge (Water), *Velocity.

Combining Bernoullis theorem and weir discharge formula, equation for water profile at side spillway can be derived, making allowance for variation in channel velocity; weir coefficient, velocity variation and extent of draw down are considered in relation to G.S. Coleman and D. Smith's results and simplified design formula are given; insertion of dip plates may reduce discharge if clearances are small.
W69-01677

THE HYDRAULIC RESISTANCE OF DRAINAGE CONDUITS,
P. Ackers.
Proc Instn Civ Engrs, Vol 19, 1961.

Descriptors: Sewers, *Flow resistance, *Roughness (Hydraulic), *Velocity, *Storm drains, Pipes.
Identifiers: *Storm sewers.

Further details are given of theoretical and experimental studies on the hydraulic resistance of sewers and storm drains, which have been carried out by the Hydraulics Research Station (see Wat. Pollut. Abstr., 1963, 36, Abstr. No. 1823) including experiments on salt-glazed, spun concrete and pitch-fibre pipes, both full and partly-full. The results, given in tables and graphs, show that flow conditions in new sewers are turbulent-transitional and that the eccentricity and spacing of the joints affect the overall roughness. Neither the Crimp and Bruges nor the Manning formulae fit the experimental data and the equation proposed by Colebrook, C.F., and White, C.M., is preferred. On the basis of data obtained, roughness values for new sewers are suggested. Under partly-full conditions, proportional velocities follow the theoretical trend, but are lower, indicating an increase in roughness for free-surface flow, the possible cause of which is discussed.
W69-01698

TABLES FOR THE HYDRAULIC DESIGN OF STORM-DRAINS, SEWERS, AND PIPE-LINES,
P. Ackers.
Hydraul Res Pap No 4, H M Stationery Office, London, 1963.

Descriptors: *Hydraulic design, *Storm drains, *Sewers, *Velocity, *Roughness (Hydraulic), *Discharge (Water), Design, Pipes.
Identifiers: *Storm sewers.

To assist in the design of sewers and storm-water drains, this publication contains tabulated data on the discharges and velocities in pipes over a range of diameters (6-96 in.) hydraulic gradients (1 in 10,000 - 1 in 10), and roughnesses (k sub s values from 0.0002-0.05 ft.).
W69-01699

RAIN DISCHARGE AND SEWAGE SLUDGE,
G. Amberger.
Gesundheit-Ing, Vol 56, p 298, 1933.

Descriptors: *Storm runoff, *Sewers, *Design, Overflow.

When the sewage flow is so divided that half continues in the same direction, half through a pipe at an angle, then about 97% of the sludge goes through the latter pipe when the angle with the original direction is 30 degrees, about 87% when it is 120 degrees. These data are significant in the construction of plant by-passes to provide for heavy flow resulting from rains so that the richer sewage goes through the plant, the dil. being by-passed to the river.
W69-01700

HYDRAULIC BEHAVIOR OF STORM WATER INLETS,
W. H. Li, J. C. Geyer, and G. S. Benton.
Sewage and Industrial Wastes, Vol 23, pp 34-6, 1951.

Descriptors: *Model studies, *Intakes, *Storm runoff, Hydraulics.
Identifiers: Capacity.

Formulae based on studies of model inlets are developed for calculating the capacities of various types of gutter inlet without depression. There was close agreement between the calculated and observed values.
W69-01704

FLOW CHARACTERISTICS OF PVC SEWER PIPE,
L. C. Neale, and R. E. Price.
ASCE Proc, J Sanit Eng Div, Vol 90, No SA3, Pt 1, paper 3955, pp 109-29, June 1964.

Descriptors: *Plastic pipes, *Sewers, *Sewer hydraulics, Velocity, Head loss, *Flow measurement.

Flow tests were run of 8 and 12-in. thin-wall, flexible PVC pipe designed for use as sewers; pressure and open channel flow characteristics were investigated and analyzed; velocity profiles were made; it is shown that temperature has significant effect that should be considered in critical or marginal designs; head losses for solvent cemented bell and spigot joint were measured, and coefficients of 0.0011 with bell pointed downstream and 0.0068 with bell pointed upstream were determined.
W69-01705

FLOW VELOCITIES IN SMALL SEWERS,
R. D. Pomeroy.
J Water Poll Control Fed, Vol 39, pp 1525-1548, 1967.

Descriptors: *Velocity, *Sewers, *Sewer hydraulics.
Identifiers: *Calculations.

Methods were developed for obtaining data on velocity and discharge in sewers for use in calculat-

ing the coefficients in hydraulic equation, and these techniques were used on 95 small sewers. The data obtained, together with published studies on experimental pipes, confirm the conditions of previous investigators that velocities in partly-filled pipes do not conform to the traditional equations. From the data obtained, equations were developed for velocities in partly-filled pipes of circular section. The experimental results also confirmed the accepted view that a velocity of 0.5-0.6 m per sec, or 1.6-2 ft per sec, is required to avoid excessive accumulations of debris. There was evidence of a retarding effect of critical-depth turbulence, but it is impracticable to avoid these effects in the smallest sewers. It was found that poor construction, including irregularities of slope, is often the cause of poor coefficients; the asbestos-cement sewers tested showed better coefficients than the vitrified-clay sewers, and the concrete sewers were poorest.
W69-01706

FLOW VELOCITY IN PARTLY FILLED PIPES,
Richard Pomeroy.
Water and Sewage Works, Vol 108, p 180, May 1961.

Descriptors: *Velocity, Flow measurement, *Pipes.
Identifiers: *Calculations.

It is important, for a variety of purposes in the sanitary engineering field, to be able to calculate velocity and flow conditions in sewers running less than full. The equation which has come to be known as Manning's is most commonly used for this purpose. This equation rests upon the classical assumption that velocity can be calculated as a function of R, S, and a friction coefficient. This basic assumption is an approximation when streams of different shape of cross section are considered. This following equation has been deduced for calculating velocity of flow in a partly filled pipe of circular cross section. V = k (Q exp. 0.29) (S exp. 0.38) (D exp. -0.13). This equation conforms to available data better than the Manning equation. The value of k is related to the Hazen-Williams coefficient by the equation k = 0.702 m C (0.71) in which m is approximately 1.10.
W69-01707

MEASUREMENT OF MANNING'S ROUGHNESS COEFFICIENT,
O. J. Schmidt.
Sewage Industr Wastes, Vol 31, p 995, 1959.

Descriptors: *Sewers, *Velocity, *Design, Construction, *Roughness (Hydraulic).
Identifiers: *Combined sewers, *Kansas City (Mo.), Urban drainage.

In connection with a master plan for trunk sewers and sewage-treatment facilities in Kansas City, Mo., a series of velocity measurements was made in a large trunk sewer carrying both sewage and storm water. The method used to measure mean velocity is described; it is considered to be as simple, accurate, and inexpensive as more conventional procedures. Variations in n in Manning's formula occur with changes in depth of flow in sewers and for certain sewer designs such variations can be important. The value of n can be changed from that used in the design of the sewer by a number of conditions brought about during construction or which can occur afterwards. Bottom deposits or other conditions which greatly alter the invert surfaces of the sewer probably caused a greater variation in n than that caused by changes in depth of flow. Some aspects on which further investigations are required, are indicated.
W69-01709

OPTIMUM DESIGN OF SEWERS,
A. A. Smith.
Civ Eng Publ Works Rev, Vol 60, p 206, 1965.

Descriptors: *Sewers, *Design.
Identifiers: Capacity, Calculations.

After a brief review of the general properties of partly full circular conduits as applied to sewer design, the author shows that the effect of shape is both significant and important in the design of sewers of adequate carrying capacity. The concept of optimal sewer diameter is developed, and the relevance of criteria of self-scouring and carrying capacity is considered. A design chart is given for the solution of problems of a general nature, with some practical examples of its use.
W69-01710

SOME HYDRAULIC ASPECTS OF SEWERAGE AND SEWAGE DISPOSAL,
C. B. Townend, and G. W. Wilkinson.
Instn Civ Engrs, Proc, Vol 4, Pt 3, No 3, pp 662-84, Dec 1955.

Descriptors: *Sewage treatment, *Hydraulics, *Storm runoff, Discharge (Water), *Velocity, *Sedimentation, *Flow control.
Identifiers: *Suspended solids.

Sequence of operations in sewers and at treatment plants; application of hydraulic principles to assure efficient transport and removal of solids; storm-water runoff, discharge formulas relating to sewers, channels and pipes; effects of sewage handling on hydraulic practice, control of velocities and levels, distribution of flow, and sedimentation procedures.
W69-01711

DRAINAGE (SEWERAGE).

J Inst of Sanit Engrs, Vol 50, pp 177-94, 1951.

Descriptors: *Storm runoff, *Overflow, Velocity, Sewers, Flow, *Runoff, Design.
Identifiers: *Lloyd-Davies formula.

In a discussion on the C.E. Code of Practice No. 5 (1950) 'Drainage (Sewerage)', subjects raised included velocity of flow in sewers, admission of trade waste waters to sewers, storm water overflows, and the Lloyd-Davies method of calculating run-off.
W69-01718

PRINCIPLES FOR CALCULATING FLOWS IN SEPARATE AND COMBINED SEWERS,
Waclaw Blaszczyk.
Gaz Woda Tech Sanit, Vol 26, No 1, p 24, 1952.

Descriptors: *Rainfall intensity, *Design, *Sewers, *Flow measurement.
Identifiers: *Combined sewers, Warsaw (Poland).

Following a review of the theory of calculating combined sewer flows by means of several expressions, the author presents time-intensity plots proposed by various authorities for Warsaw, in which intensities for a rainfall of 1/2 min. vary from 25 to 202 l. per second per hectar; for t = 1 min., i varies from 16 to 124; for t = 2 min., i varies from 12 to 70; and for t = 3 min., i varies from 9 to 58. In many projects, the results are based upon the experience of the designer as indicated by the data cited above. Accordingly, the author proposes that it is necessary to come to some agreement as to the coefficient of probability to be used for economical sewer design, and that it should not be necessary to depend wholly upon the judgment of the designer. Of course, the establishment of suitable norms must be based upon thorough and complete calculations and review of existing data. No one, according to the author, has dependable results, as practically none of the designers have had the opportunity of confirming their calculations in practice, because in many cases the system has not been completed as designed, the drainage area has not been fully settled, or the rains designed for have not occurred.
W69-01727

INFILTRATION INTO SEWERS.

N Z Eng, Vol 14, pp 233-238, 1959.

Descriptors: *Storm runoff, Sewers.
Identifiers: *Sewer infiltration.

In 1957 the Council of the New Zealand Institution of Engineers set up a committee to investigate into the excessive infiltration and entry of storm water into sanitary sewers. In the first report of the committee, the results of a questionnaire sent to various authorities are summarized, and conclusions drawn therefrom are studied. It appears that storm-water entry and/or infiltration is serious in 75 per cent of the systems studied. It is recommended that further investigation should be made into causes of infiltration and possible remedies, including the preparation of a code of good practice in the laying of sewers and drains.
W69-01732

EXFILTRATION TESTING OF LARGE SEWERS.

Public Works, p 108, Jan 1968.

Descriptors: *Sewers, Construction.
Identifiers: *Sewer infiltration, *Sewer exfiltration.

Infiltration and exfiltration methods for ground water leakage into sewers are compared. Tests were performed on sewer pipes rangin g from 27 to 72 in. Test results showed that exfiltration testing is a valuable tool in sewer construction.
W69-01733

ESTIMATING THE CAPACITY OF SEWERS AND STORM DRAINS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01751

EFFECTS OF USE ON THE HYDRAULIC RESISTANCE OF DRAINAGE CONDUITS,
P. Ackers, M. J. Crickmore, and D. W. Holmes.
Proc Instn civ Engrs, Vol 28, Pap No 6743, pp 339-359, 1964.

Descriptors: *Pipes, Drainage systems, Conduits, Roughness (Hydraulic), *Aging (Physical), Deterioration.
Identifiers: *Capacity.

As a sequel to studies on the hydraulic roughness of new sewer pipes (see Wat. Pollut. Abstr., 1963, 36, Abstr. No. 2021), field experiments were carried out to obtain information on the probable deterioration of capacity with age and use. The studies, in which both salt-velocity and radioactive-tracer techniques were used (the iodine-132 method being found most convenient for use in sewers), were carried out at 20 sites giving a wide range of pipe materials, sizes, gradients, and degrees of sliming; and roughness values were calculated using the Colebrook-White equation for turbulent flow. Slime became established in sewers after a relatively short period of use and tended to predominate near the normal water level, but the degree of sliming varied considerably at the different sites, probably depending on the composition of the sewage as well as the boundary shear. Layers of slime less than 1/8-inch thick had little effect on the resistance to flow or the capacity of the pipe, but above this level the resistance to flow increased rapidly with thickness of slime. Compared with slime, the presence of sediment in the invert had more marked effects on the roughness values particularly under conditions such that standing waves were produced. The effects of sediment varied widely depending on the 'bed form' (a function of particle size) and the flow conditions. Based on the experimental results, roughness values are recommended for mature foul sewers.
W69-01752

8C. Hydraulic Machinery

AUTOMATIC CONTROL VALVES,
R. H. Babcock.
Water Wastes Eng, Vol 5, No 1, pp 43-5, Jan 1968.

Descriptors: *Automatic control, *Flow control, *Instrumentation, Sewage treatment, Hydraulics.
Identifiers: *Calculations.

Many specialized valves are now incorporated in the automatic control of sanitary systems and successful application of a control valve to a process requires complete understanding of the hydraulics of the system under design. Design techniques for control problems involve flow of reagents (pH control), pipeline losses, inlet losses, outlet losses, and fitting losses. In every case a valve can be considered a control of simple flow between two reservoirs. A valve may also be considered a variable orifice. Derivations of sizing equations for (1) liquids, (2) gases and (3) steam and other vapors are given. A table presents typical valve coefficients for valve types such as butterfly, needle, and wide range V port. Some typical valve sizing problems are presented and solved by application of the equations derived.
W69-01660

BUILT TO BE SEEN,
Wilsey and Ham, San Mateo, Calif.
Daniel W. Klar.
Amer City, pp 96-97, May 1967.

Descriptors: *Pumping, *Storm runoff.

A pump station in Foster City, Calif. is described. The station serves a community with an expected population of 35,000 in 1977, and with an average elevation of 4.5 ft. above sea level. The station has a system of levees, collecting lagoons and waterways for storm drainage. The pumps circulate 400,000,000 gals. of water each week to keep lagoons and waterways clean and clear. Pumping equipment and station layout are described.
W69-01675

FLUSHING OF SEWER NETWORKS: AUTOMATIC DISCHARGE DEVICE,
A. Lencastre.
Mem Minist Obr Publ, Lisbon, No 109, 1957.

Descriptors: *Automatic control, Instrumentation.
Identifiers: *Sewer flushing.

Investigations were carried out on 3 automatic discharge systems for use in flushing sewers, to determine the effectiveness of automatic operation even at very small rates of flow.
W69-01676

AUTOMATIC CONTROL OF PUMPING INSTALLATIONS,
I. M. E. Aitken, and R. A. F. Craven.
Effluent and Water Treatment Convention, London, 1965. 10 pp.

Descriptors: *Pumping, Automatic control, *Overflow.

In discussing the application of automatic control devices in sewage pumping stations, the authors describe and give a schematic diagram of a single-range control system in which two electrode probes in the inflow-reception sump are used in conjunction with a simple programme controller to control the operation of a number of single-speed pumps of different ratings which can be brought into service in different combinations. The same system can also be used to adjust the rate of pumping in relation to the amount of storm-water overflow and to control the rate of pumping in the recirculation of effluent at sewage works. The basic principles of the system are also applicable when other level-sensing devices are used instead of the electrode probes in the reception sump.
W69-01680

PVC SEA OUTFALL IN HUNSTANTON SEWAGE SCHEME.
Survr Munic Cty Engr, Vol 128, No 3876, pp 22-24, 1966.

Descriptors: Outlets, Storm runoff, *Overflow, *Pumping, Automatic control, Plastic pipes.

An illustrated description, with a plan of the outfall pumping station, is given of the installation at Hunstanton, Norfolk, of a 10-in diameter polyvinylchloride submarine outfall 0.5 mile long, consisting of 20-ft lengths of pipe with acetone cement joints. Subsidiary pumps convey crude sewage to the outfall pumping station; at low tide and normal rates of flow the outfall conveys the sewage under gravity, but at high tide or for high rates of flow the pipeline becomes surcharged and the outfall pumps operate automatically when an overflow sump fills. Provision is made at the pumping station for comminution, the disintegrator being controlled automatically by a lunar clock to operate when the tide is ebbing. Flows in excess of 4.5 times the dry-weather flow are discharged through a separate storm-sewage outfall, a cast-iron pipe extending to the mid-tide mark.
W69-01687

NEW SEWAGE WORKS COMMISSIONED AT LEICESTER.
Survr Munic Engr, Vol 124, No 3773, pp 25-27, Sept. 26, 1964.

Descriptors: *Overflow, *Storm runoff, Weirs, Pumping.
Identifiers: Storage tanks.

These works are designed for a dwf of over 20 million gal and are capable of extension to treat 22 1/2 million gal. On reception, sewage passes through screens and detritors, screenings being returned to flow through disintegrators; washers clean the grit, which is then pumped to a tip at the edge of the works. A weir overflows storm water in excess of 85 million gal/d direct to the River Soar; the residual flow is lifted 12 ft by 6 centrifugal pumps to permit gravitation through the works. Two of these pumps, each of which has a capacity of 7,500 gal/min, are driven by variable-speed motors controlled by electrodes in the pump well, which allows for changes in flow. Two 24-in. diesel-driven pumps are used for pumping to the storm water tanks.
W69-01688

OPERATING EXPERIENCES AT SWINDON, 1962 - 1967,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-01696

FLOOD RELIEF SCHEME FOR WEST LONDON.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01763

8D. Soil Mechanics

FLOOD SURGE ON THE RUBICON RIVER, CALIFORNIA--HYDROLOGY, HYDRAULICS AND BOULDER TRANSPORT,
U S Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-01610

LABORATORY INVESTIGATION OF SOIL INFILTRATION THROUGH PIPE JOINTS,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01749

8G. Materials

POLYMER COAGULATORS.
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-01701

SEWER INFILTRATION.

Water Wastes Eng, Vol 4, No 10, p 22, Oct 1967.

Descriptors: *Sewers, Pipes, Sealants, Pumping, *Biochemical oxygen demand.
Identifiers: *Sewer infiltration, *Residential sewers, *Suspended solids.

Engineers of sewage treatment facilities in six areas of the U.S. were surveyed concerning sewer infiltration: frequency of determination of the extent of infiltration, percentage of sewer flow resulting from infiltration, steps to reduce infiltration, and effect of infiltration on the treatment plant operation. Infiltration was reported to be a problem in each area. Steps used to curb infiltration were: prompt repair of broken or damaged sewers, replacement of sewer pipe with pipes of materials better suited for the area, and enforcement of ordinances prohibiting footing drains and downspouts. High cost prevented the use of sewer linings and chemically-sealed joints. Root infestation was also a problem in each area surveyed. It is the most difficult source of infiltration to locate and correct and may account for as much as 50% of total infiltration. Infiltration affected treatment plant operation by increasing the cost of pumping and reducing BOD and suspended solids. Percentage of the total flow in the sewers resulting from infiltration was estimated to vary between 10 and 50%.
W69-01735

DETECTION AND SEALING OF LEAKS IN SEWERS,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01738

PIPE JOINTS LIMIT INFILTRATION,
G. W. Clark, Jr., and M. L. Leyrer.
Civ Eng, Vol 37, No 1, pp 62-3, Jan 1967.

Descriptors: Sewers, Construction, *Manholes.
Identifiers: *Sewer infiltration.

City engineers in Muskegon, Mich, designed sanitary sewer trunk that would be placed in area having high water table; limiting infiltration was most important; this was accomplished through use of rubber O-ring joint gaskets, and good construction and inspection procedures; tests on completed line show infiltration to between 14.5 and 55.7% of maximum allowable rate of 200 gal/in. of internal diameter per mile of pipe per day; much of this infiltration took place at precast manhole joints, which did not have rubber O-ring joint specified.
W69-01739

EXFILTRATION TESTING OF LARGE SEWERS IN KANSAS CITY, MO.,
For primary bibliographic entry see Field 05B.
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W69-01741

ELIMINATING INFILTRATION OF GROUND WATER INTO SEWERS,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01743

INFILTRATION AND SEWER FOUNDATIONS,
F. W. MacDonald, J. K. Mayer, and S. E. Steimle.

Pub Works, Vol 98, No 12, pp 105-7, Dec 1967.

Descriptors: *Sewers, *Design.
Identifiers: *Sewer infiltration, Gulf Coast.

Study was initiated to determine most suitable foundation materials and best types of sewer arrangements, under various conditions, which will effectively decrease and control infiltration in Gulf Coast area, and to test various foundation materials and arrangements in combination with various lay-

ing conditions in order to determine most suitable bedding in number of soil types common to area.
W69-01746

INFILTRATION AND SEWER FOUNDATIONS,
Tulane Univ., New Orleans, La.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-01747

SEAL SEWER LEAKS FROM INSIDE,
R. Nooe.
Am City, Vol 79, No 6, pp 91-2, June 1964.

Descriptors: *Sealants.
Identifiers: *Sewer infiltration.

Method recommended to repair sewers from inside using special internal injection techniques controlled and observed by TV camera; injected chemical gel stops infiltration and is reported to lower cost of sewer rehabilitation.
W69-01750

EPOXY SOLVES HAZARDOUS SEWER LINING PROBLEM,
F. V. Cornelius.
Pub Works, Vol 98, No 1, p 126, Jan 1967.

Descriptors: Sewers, *Sealants.
Identifiers: *Storm sewers, Polymers.

Utilization of epoxy materials for lining large storm sewer following explosion while heating asphalt mixture for lining; Commercial Chem Co, Cincinnati, Ohio, supplied Epo-Patch and Epo-Surfacer compounds to trowel in invert and spray top part of corrugated pipe; thickness of epoxy application ranged from 10 mils to 6 in.; approximately 82 gal were required for complete lining of sewer.
W69-01776

8I. Fisheries Engineering

BLAKE V UNITED STATES (OBSTRUCTIONS IN NAVAL ANCHORAGE AREA).
For primary bibliographic entry see Field 06E.
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VOLUME 2, NUMBER 6
MARCH 15, 1969

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Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is $22.00 (domestic), $27.50 (foreign); single copy price is $3.00.

SELECTED
WATER RESOURCES ABSTRACTS

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Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

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- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
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02. WATER CYCLE

2A. General

ROLE OF DIGITAL COMPUTERS IN HYDROLOGIC FORECASTING AND ANALYSES,
For primary bibliographic entry see Field 07C.
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THE ROLE OF PARAMETRIC HYDROLOGY,
University College, Galway, Ireland.
J. E. Nask.
Instn Water Eng J, Vol 21, No 5, pp 435-474 July, 1967 25 ref.

Descriptors: *Rainfall-runoff relationships, *Hydrographs, Storm runoff, Model studies.
Identifiers: *Calculations.

Parametric hydrology is defined and its advantages, uses and techniques are described. The rational method is briefly described. A method of graphical correlation of observed volumes of storm run-off to the amounts and duration of rainfall and conditions in the basin at the time of the storm is described. The unit hydrograph method of measuring the distribution of run-off in time is presented. Equations and parameters are developed for this method based on basin characteristics and other variables. Conceptual models and hydrologic frequency are discussed. A lengthy discussion follows the paper.
W69-02249

REGRESSION MODELS FOR PREDICTING ON-SITE RUN-OFF FROM SHORT DURATION CONVECTIVE STORMS,
H. A. Schreiber, and D. R. Kincaid.
Water Resour Res, Vol 3, pp 389-395, 1967.

Descriptors: *Storm runoff, *Rainfall intensity, *Model studies.
Identifiers: *Calculations.

Experimental plots were used to study the on-site run-off resulting from 34 summer convective thunderstorms in the Walnut Gulch experimental watershed, Ariz. It was found that run-off increased with increase in precipitation and decreased as antecedent soil moisture and crown spread of vegetation increased. Six independent variables were used in a step-wise multiple linear regression equation to determine the importance of total quantity per storm in inches; maximal 5-minute intensity in inches per hour; and duration of storm in minutes.
W69-02260

WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA,
W. M. Snyder.
Int Geodetic and Geophysical Union-Sec for Sci Hydrology Publ No 63, pp 18-30, 1964.

Descriptors: *Rainfall-runoff relationships, Runoff, Watersheds, Model studies.
Identifiers: *Calculations.

Mathematical model has been developed to analyze past records of streamflow and to predict dependable yield from watersheds under varying patterns of rainfall; model contains three parts; first, seasonal rainfall function generates potential runoff in two phases--immediate and delayed; second, distribution function delivers delayed runoff to future streamflow; third, time-trend function compensates for changing watershed conditions; ten test sets of data were analyzed.
W69-02266

SIMPLIFIED VERSUS OPTIMUM UNIT HYDROGRAPHS - ONE COMPARISON,
W. W. Snyder.
Water Resources Res, Vol 3, No 4, pp 947-948, 1967.

Descriptors: *Hydrographs, *Rainfall-runoff relationships.
Identifiers: *Urban hydrology.

A unit hydrograph is derived from a record storm previously analyzed for the optimum realizable unit hydrograph. The storm data, an urban rainfall-runoff event, and original analysis are given in Eagleson. et al Water Res. Res 2 (4):755. The simplified curve-fitting procedures produce a more rational appearing unit hydrograph in this case study.
W69-02267

RAINFALL AND RUN-OFF IN THE DERWENT VALLEY TO YORKSHIRE BRIDGE, DERBYSHIRE,
R. W. S. Thompson, and K. J. H. Saxton.
Proc Instn Civ Engrs, Vol 25, Paper No 6664, pp 147-164, 1963.

Descriptors: *Rainfall-runoff relationships.

Tabulated hydrometric data over the past 60 years are given for the catchment area of the Derwent Valley Water Board on the river Derwent in north Derbyshire. The relations between rainfall and run-off in the area are discussed.
W69-02272

HYDROLOGICAL OBSERVATIONS,
S. J. van Kregten.
Verslagen en Mededelingen, No 9-Verslag van de Technische Bijeenkomst, No 18, pp 12-27, 1963.

Descriptors: *Rainfall-runoff relationships, Discharge (Water), *Hydrographs, Storm runoff, Surface runoff, Groundwater.
Identifiers: *Calculations.

Hydrological observations; elements of transformation of precipitation to runoff are given on basis of diagram of hydrological cycle; methods used to determine discharge from rainfall are reviewed, with special attention to unit-hydrograph method for surface runoff; analytical method developed in Netherlands for calculation of groundwater discharge; behavior of flood wave in open channels is discussed.
W69-02273

CHARACTERISTICS OF THE INLET HYDROGRAPH,
W. Viessman, Jr., and J. C. Geyer.
ASCE Proc, J of Hydr Div, Vol 88, No HY5, p 245, 1962.

Descriptors: *Rainfall-runoff relationships, *Intakes, *Rainfall intensity, Roughness (Hydraulic), Runoff, *Hydrographs.
Identifiers: *Urban drainage, *Surface permeability.

The results of a study of the relationship between rainfall and runoff for impervious inlet areas are presented. An attempt has been made to include as many significant variables as possible. Prominent among the latter were antecedent rainfall storm intensity and pattern, and size, slope, and roughness of the inlet areas. Data from records on impervious areas in Baltimore, Md., Newark, Del., and Hertfordshire, England. Equations for peak rates of runoff, rise of hydrograph, and method proposed for predicting shape of simple hydrograph.
W69-02275

A HYDRAULIC MODEL FOR THE CATCHMENT-STREAM PROBLEM. III. COMPARISON WITH RUN-OFF OBSERVATIONS,
R. A. Wooding.
J Hydrol, Vol 4, pp 21-37, 1966.

Descriptors: *Model studies, *Rainfall intensity, Discharge (Water), *Hydrographs, *Rainfall-runoff relationships, Drainage.

The application to field measurements of a hydraulic model of a V-shaped catchment draining into a stream situated in the apex of the V is discussed, together with the mode of determination of unknown parameters after choosing parameters for the rainfall intensity scale, catchment equilibrium time, the scale of the discharge hydrograph, and the ratio of stream-equilibrium time to catchment equilibrium time. Comparisons of discharge hydrographs calculated from the theoretical model are made with those from catchment areas at Cashmere, New Zealand, and at Alice Springs and Warragamba Dam, Australia. Improvements are suggested, including the need for a better geometrical description of the stream network in examples, and it is pointed out that a more efficient treatment of infiltration losses might be possible with a model based on stream networks.
W69-02277

HYDRAULIC MODEL FOR CATCHMENT-STREAM PROBLEM,
R. A. Wooding.
J Hydrology, Vol 3, No 3-4, pp 254-82, 1965.

Descriptors: *Model studies, Discharge (Water), *Hydrographs, Rainfall intensity, *Rainfall-runoff relationships.

Analytical solutions for hydraulic model are obtained by method of characteristics, firstly, for flow over plane V-shaped catchment under constant uniformly-distributed rainfall of finite duration, and secondly, for stream outflow arising from catchment discharge predicted form of stream hydrograph is calculated numerically, assuming that rainfall is of constant intensity and of finite duration.
W69-02278

WATER-OUR SECOND MOST IMPORTANT NATURAL RESOURCE,
Rensselaer Polytechnic Institute.
Donald B. Aulenbach.
Boston College Ind and Com L Rev, Vol 9, No 3, pp 535-552, Spring 1968. 18 p, 42 ref.

Descriptors: Chemical properties, Electrical properties, Compressability, Ionization, Surface tension, *Hydrologic cycle, *Rainfall runoff relationships, *Surface runoff, Evapotranspiration, Water balance, Groundwater, Recharge, Lakes, Desalination, Consumptive use, Water yield improvement, Distribution, *Economic feasibility.

The importance of water to man and its unique properties are summarized. In order to determine the supply of usable water an inventory of the earth's total supply is set forth in table I. 99.2% of the supply, comprised of salt water and glaciers, is virtually unusable. 98.3% of the remainder is groundwater, 50% of which is reasonably accessible. Stream runoff is the portion which is readily available to man. Presently there is an annual water use in the United States of 450 million acre feet per year with an average stream runoff of 1372 million acre feet per year. This potential supply is not necessarily unpolluted, however, although at present there is sufficient available water to meet demands. Tables are included with a breakdown of water uses showing a tenfold increase in the last 70 years with the greatest increases in power generation and industrial uses. Due to population increases and increased industry it is estimated that by 1980 water demands will exceed the amount of water readily available. Four methods are suggested for increasing the supply: desalting sea water; imports from areas of large supply; weather modification; and salvage measures. The feasibility of each is discussed. It is suggested that demand might be reduced by raising water prices. (Kahle-Fla)
W69-02332

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THE EFFECTS OF URBANIZATION ON UNIT HYDROGRAPHS FOR SMALL WATERSHEDS, HOUSTON, TEXAS, 1964-67,
W. H. Espey, Jr., and D. E. Winslow.
Rep by TRACOR, Sept 1968; Vol 1, Doc No 68-975-U, text, 70 p, 19 fig, 8 tab, 8 ref, Contract No. 14-01-0001-1580; Vol 2, Doc No 68-1006-U, append-data compilation, 244 p, many fig and map, 10 ref. OWRR Supported by Title 11, Water Resources Act, 1964.

Descriptors: *Urbanization, *Storm runoff, *Rainfall-runoff relationships, *Unit hydrographs, Regression analysis, Drainage systems, Land use, Roads, Vegetation effects, Infiltration, Small watersheds, Environmental engineering.
Identifiers: Linear regression analysis, Houston (Texas), Urban watersheds.

Rainfall-runoff relations were studied on several small watersheds in Houston, Texas, to learn the effects of urbanization and to develop equations to describe the effects of urbanization on unit hydrographs. Rainfall and runoff data from 11 urban and 6 rural watersheds were reduced and 30-minute unit hydrographs obtained. This was combined with previously reduced data for 22 urban and 11 rural watersheds. The Houston Urban Project of the USGS, WRD, provided most of the basic data. Multiple linear regression analysis was used to develop equations to describe the 30-minute unit hydrograph for urban and rural conditions. These equations were compared to previously derived equations and the equations of best fit were determined. The equations are used to predict effects on the unit hydrograph of changes in impervious cover, channel conditions and secondary drainage facilities due to urbanization. Applied to Houston watersheds they indicate that in changing from a rural to a highly urbanized condition the 30-minute unit hydrograph may show an increase in peak discharge of up to 500% and a decrease in time of rise of up to 90%. Appendices published in a separate volume contain unit hydrographs, descriptions and maps of the watersheds, basic hydrologic data, and equations developed by regression analysis. (Knapp-USGS)
W69-02354

FLOW OF THE RIO GRANDE AND RELATED DATA - FROM ELEPHANT BUTTE DAM, NEW MEXICO TO THE GULF OF MEXICO - 1966.
International Boundary and Water Commission, U. S. and Mexico.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02355

2B. Precipitation

DOUBLE-MASS ANALYSIS ON COMPUTER,
R. Singh.
ASCE Proc, J Hydraulic Div, Vol 94, No HY 1, Paper 5729, pp 139-42, Jan 1968.

Descriptors: *Computer programs, *Precipitation.
Identifiers: *Calculations.

Hydrologists use double-mass analysis to verify consistency of precipitation or streamflow record; precipitation of station is plotted against combined precipitation of surrounding stations; consistency of record is verified if single straight line fitted through points is reasonable; analysis is done on computer by fitting straight line and fourth-degree polynomial through points and comparing two sums of squares of deviations of points from fitted curves; if record is found to be inconsistent, it is adjusted by bringing deviated points along desired single straight line; method should be of value to hydrologists having access to computers.
W69-02263

RAINFALL RATES OF HEAVY RAINS IN BREMEN,
W. Storch, and F. W. Boll.
Gas-Wasserfach, Vol 109, No 6, pp 156-157, 1968.

Descriptors: *Rainfall intensity.
Identifiers: *Calculations, *Bremen (Germany).

Recent measurements of the rainfall intensity-duration relationship, which the municipal authorities of Bremen, Germany carried out at four measuring stations, have shown that the rainfall intensity-duration curve used for years does not correspond to present conditions. The old value was in error of 67% for 25 minutes. A new rainfall intensity-duration curve was constructed using Hoerler's method, which provided the author with data that could be used to determine rainwater rates for rainfalls of any duration and frequency. The newly constructed curve not only differs greatly from the old data, but also disagrees with the Reinhold data so far accepted as valid for the whole northwestern part of Germany.
W69-02269

STORM STUDIES IN SOUTH AFRICA-SMALL-AREA HIGH-INTENSITY RAINFALL,
W. van Wyk, and D. C. Midgley.
Civ Engr in South Africa, Vol 8, No 6, pp 188-97, June 1966.

Descriptors: *Rainfall intensity, *Design.
Identifiers: South Africa.

Intensity-duration-frequency relationships, time distribution of intense rainfall, and areal distribution of rain within intense storms are dealt with; to enable relationships to be extended to ungaged localities, coaxial plot of intensity, duration, frequency, mean annual rainfall and rainfall region is presented; dimensionless curve is provided as basis for synthesizing mass curve of rainfall during 'design storm'; third diagram is presented as basis for determining isohyetal pattern of design storm; application to design is illustrated by example.
W69-02274

ARIDITY DEFINITIONS AND THEIR APPLICABILITY,
Swedish Meteorological and Hydrological Institute, Stockholm.
C. C. Wallen.
Geografiska Annaler, Vol 49A, No 2/4, pp 367-384, 1967. 18 p, 4 fig, 2 tab.

Descriptors: Water balance, Climatic data, Arid climates, Semiarid climates, Investigations, *Climatology, Meteorology, *Equations, *Temperature, Precipitation, Evapotranspiration, *Rainfall.
Identifiers: *Aridity, *Indices, Agricultural potential, Near East, Agroclimatology.

A review of the various approaches to the problem of defining aridity were given. The classical, Index, and water-balance approaches were discussed with particular emphasis on a critical analysis of the different indices developed by Koppen, deMartonne, Emberger, and Gaussen. In the latter part of the article a summary was given of an investigation, which was an attempt to establish from the available climatological information, the agricultural potentialities of the semi-arid and arid regions in the Near East. The countries involved were Lebanon, Syria, Jordan, Iraq, and Iran. The results from a purely classical approach were compared with an approximate determination of the water-balance conditions based on Penman's formula. (Affleck-Ariz)
W69-02384

2C. Snow, Ice, AND Frost

A PRELIMINARY ESTIMATE OF THE ICE-SEASON ENERGY BALANCE FOR THE NIAGARA RIVER,
Meteorological Service of Canada, Ontario, Hydrometeorology Section.
H. L. Ferguson.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 41-58, Sept 1968. 18 p, 2 fig, 9 tab, 20 ref.

Descriptors: *Heat budget, *Rivers, *Ice, *Climatic data, *Hydrologic data, Freezing, Melting, Radiation.
Identifiers: *Energy balance, Niagara River, Canada.

Part of a study by the Meteorological Service of Canada and the Ontario Hydro-electric Power Commission on ice formation and dissipation on the upper Niagara River is an estimated energy budget of the river, based on long term climatological data and on hydrological observations made in the 1967 ice season. The measured and estimated terms in the energy budget are net incoming radiation, net energy loss by evaporation, conduction to the atmosphere, loss by snowmelt, incoming advected energy, outgoing advected energy, and net gain in energy storage. Storage and advection are the most difficult to measure or accurately estimate. Ice forecasting methods by multiple-regression methods may be possible. Lack of precision in measurements of storage and advection terms limits the use of the energy budget equation as a direct ice-prediction method. (Knapp-USGS)
W69-02335

2D. Evaporation and Transpiration

RAINFALL AND EVAPORATION: DISTRIBUTION IN SPACE AND TIME,
P. J. Meade.
J Inst Water Eng, Vol 21, No 3, pp 210-215, May 1967.

Descriptors: *Rain gages, *Data collections, *Rainfall intensity.
Identifiers: Urban drainage.

The Meteorological Office is undertaking intensive research into the problems of the measurement, collection, and analysis of data on rainfall and subsequent evaporation to use in future planning of both water resources and water disposal. Water disposal problems requiring an accurate analysis of rainfall data include: urban drainage, roof drainage, protection of dams, embankments for railways and roads, etc. However, meteorologists are aware of another set of problems which must be attacked with determination if a comprehensive service of information and advice is to be provided in this field. These problems are concerned with the forecasting of rainfall, the time of onset, the duration, and the quantity that will fall; they range over a wide area of meteorology from the physics of clouds to the large-scale movements of the general circulation of the atmosphere.
W69-02247

SPRING TRANSPIRATION OF THREE DESERT SPECIES,
Nevada Univ., Reno, Nevada. Desert Research Institute.
N. Stark.
J Hydrol - Amsterdam, Vol 6, No 3, pp 297-305 June 1968. 9 pp, 3 fig, 1 tab.

Descriptors: *Transpiration, Desert plants, Sagebrush, Rabbitbush, *Hygrometry, *Water loss, Arid climates, Growth rates, Lysimeters, *Leaves, *Spring, Weight, Data collections, Sun.
Identifiers: Horsebrush, Hygrosensor, Dry leaf weight, Dry sites, Wet sites, Shade.

Transpiration rates of sagebrush, rabbitbrush and horsebrush were determined at a site north of Reno, Nevada. The techniques that were used explored the possibility of using the grams of water lost per gram of dry leaf weight as a basis for defining transpiration rather than the conventional method of relating loss to leaf surface area. The weight approach was being studied because it was impossible to accurately determine the surface area of many desert species. The hygrosensor area transpirometer used in the study made it possible to compare water loss from whole, living plants of the same species growing in close proximity on wet and

dry sites in the field. Data which were not corrected for weight differences showed that sagebrush lost more water per plant per minute than did rabbitbrush on a dry site. Rabbitbrush transpired more rapidly on a dry site per gram of dry weight than did sagebrush. The dry weight of leaves was a more desirable reference for transpiration rate than was leaf area which was used for broad-leaved plants. (Blecker-Ariz)
W69-02376

CONTROL OF LEAF STOMATA--THEIR ROLE IN TRANSPIRATION AND PHOTOSYNTHESIS,
For primary bibliographic entry see Field 02I.
For abstract, see .
W69-02379

WATER LEVEL FLUCTUATION IN EVAPOTRANSPIROMETERS,
U. S. Geological Survey, Phoenix, Arizona. Water Resources Div.
T. E. A. Van Hylckama.
Water Resources Research, Vol 4, No 4, pp 761-768, Aug 1968. 8 p, 5 fig.

Descriptors: *Evapotranspiration, Diurnal, Heating, Cooling, Tidal effects, *Water level fluctuation, Tamarisk, *Instrumentation, *Fluctuation, Transpiration, *Atmospheric pressure, Temperature.
Identifiers: *Evapotranspirometers, *Tanks, Plastic lining.

The effects of diurnal variation due to daily heating and cooling of the air and semi-diurnal variations due to the tidal effects of the moon on water levels in eleven plastic lined evapotranspirometers were studied in Buckeye, Arizona. Eight of the tanks were planted to salt cedar and three were left bare. The levels of the artificially maintained ground water in these instruments showed distinct diurnal fluctuations. Such a response was thought to be due to either air bubbles in the saturated zone, or the flexible plastic lining of the tank. On vegetated tanks that were transpiring the water level and the barometric curves were out of phase but if the water levels were corrected for atmospheric pressure fluctuations a curve appeared that represented the hourly rate of water use. (Affleck-Ariz)
W69-02382

USE OF ATMOMETERS IN ESTIMATING EVAPOTRANSPIRATION,
California Dept. of Water Resources, Sacramento, California.
John W. Shannon.
J. Irrig and Drain. Div ASCE. Vol 94, No IR3, Proc Paper No 6120. pp 309-320, Sept. 1968.

Descriptors: *Atmometers, Instrumentation, Evaporation, *Climatic data, *Evapotranspiration, Evaporation pans, Water requirements, Data collections, Energy, *Monthly, *Seasonal, Water loss.
Identifiers: Evaporative demand, Crop coefficients.

Studies conducted by the California Department of Water Resources during the past 10 years show that Livingston black and white spherical atmometers provided a practical means of estimating monthly and seasonal evapotranspiration. The difference of evaporation between the black and white atmometers was affected primarily by short wave energy, whereas evaporation from either the black or white atmometer provided an index of the total amount of energy available for evapotranspiration. Various studies were made, the results of which indicated that the type of background has little effect upon the difference in evaporation between the black and white atometers. Monthly crop coefficients were developed for some of the principal crops in the Central Valley of California, which provided evapotranspiration estimates consistently as good as or better than could be obtained using coefficients developed from United States Weather Bureau Class A evaporation pan data. (Affleck-Ariz)
W69-02387

THE GAS DIFFUSION POROMETER TECHNIQUE AND ITS APPLICATION TO THE MEASUREMENT OF LEAF MESOPHYLL RESISTANCE,
Hebrew Univ of Jerusalem, Dept. of Botany.
J. Gale, Alexandra Poljakoff-Mayber, and I. Kahane.
Israel J Bot, Vol 16, No 4, pp 187-204. 1967. 18 p, 3 fig, 4 tab.

Descriptors: *Transpiration, Measurement, *Leaves, Pores, Gases, Absorption, Carbon dioxide, Diffusion, Photosynthesis, Plant physiology, Stomata, Equations, *Resistance, *Water vapor, *Water loss, Vapor pressure, Density.
Identifiers: Air vapor density gradient, Mesophyll, *Gas diffusion porometer, Porometers.

A critical study of the use of the diffusion porometer method for the evaluation of mesophyll resistance to water vapor loss was conducted by the authors. Apparently significant mesophyll resistance was found in maize leaves under conditions of low leaf to air vapor pressure gradients. Calculations showed that this resistance had a considerable effect on transpiration and on the estimation of mesophyll resistance to carbon dioxide uptake. Due to the considerable experimental error inherent in the technique, this finding should be treated with reservation. Negative values of mesophyll resistance were found in maize leaves subjected to high vapor pressure gradients and in beans even under conditions of low vapor pressure gradients. These results were ascribed to the development of a tortuosity resistance which was greater than the series sun of the internal resistances to diffusion from the separate sides of the leaf. (Affleck-Ariz)
W69-02391

2E. Streamflow and Runoff

THE DESIGN OF STORM SEWERS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02178

SOLUTION FOR STORM SEWER SYSTEM PROBLEM,
L. E. McMahon.
Am Assn State Highway Officials-Committee on Electronics-Regional Conf on Improved Highway Eng Productivity, Chicago, Ill., pp VII-14-25, April 19-20, 1963.

Descriptors: *Computer programs, *Design, *Rainfall intensity, *Rainfall-runoff relationships.
Identifiers: *Storm sewers.

Program was developed at Michigan State Highway Dept for solution of storm sewer system problem created by accelerated highway program; program is written for processing on 20 K IBM 1620 computer equipped with floating point and indirect addressing features; solution is based on use of 'Rational Method for Design of Storm Sewer Systems', Manning formula and use of rainfall intensity and runoff curves developed to meet Michigan's needs.
W69-02186

STORM SEWER DESIGN FACTORS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02195

DESIGN OF STORM SEWER SYSTEMS,
L. H. Watkins.
Chartered Mun Engr, Vol 90, No 11, pp 337-41, Nov 1963.

Descriptors: *Design, *Rainfall-runoff relationships, *Computer programs.
Identifiers: *Storm sewers, *Urban drainage.

Research into relation between rate of rainfall and rate of runoff from urban areas; new method of calculating sewer sizes developed as result of research is described; programs for electronic digital computer have been evolved to enable method to be used simply and economically for designing new sewer systems and examining and redesigning existing systems.
W69-02204

A LAKE'S RESPONSE TO ITS ENVIRONMENT,
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-02217

AN INVESTIGATION INTO INFILTRATION AND INTERCEPTION RATES DURING STORM RAINFALLS AND THEIR APPLICATION TO FLOOD PREDICTION,
For primary bibliographic entry see Field 08D.
For abstract, see .
W69-02242

VARIATION OF RUN-OFF COEFFICIENT,
K. J. Mawson.
N Z Eng, Vol 14, 38, 1959.

Descriptors: *Drainage system, *Storm runoff, *Runoff forecasting, Storms, *Rainfall intensity, Design.
Identifiers: *Urban drainage, *Wellington (N.Z.).

At Wellington, N.Z., for about 30 years, stormwater drainage systems have been designed satisfactorily on the basis of the runoff-estimated by the rational method, which assumes that the highest peak flows from small catchments are produced by storms of the short-duration, high-intensity type, and generally makes no provision for prolonged falls of relatively low intensity. Data on the rainfall and floods in the residential suburb of Karori and in the bush-covered Wainui water-supply catchment area are presented and discussed with particular reference to the behavior of the run-off coefficient. It is concluded that the short-period high-intensity type of storm does not produce peak floods as high as those attained in longer storms of more moderate intensity, and that the rational method is valid for designing drainage systems for the prolonged type of storm. The run-off coefficient can be calculated with reasonable accuracy by the method in the 'Provisional Standard' of the Soil Conservation and Rivers Control Council, N. Z.
W69-02246

EFFECTS OF CLIMATOLOGIC AND BASIN CHARACTERISTICS ON ANNUAL RUN-OFF,
S. E. Mustonen.
Wat Resour Res, Vol 3, pp 123-130, 1967.

Descriptors: *Runoff forecasting, Surface runoff.
Identifiers: *Calculations, Surface permeability, Finland.

Regression analysis was used to select climatological and basin characteristics affecting the annual run-off in Finland. Seasonal precipitation and mean annual temperature were found to be much more important than basin characteristics such as soil type and vegetation; frost depth was inversely related to run-off; while percentage areas of cultivated land and peat land were not significant factors. The statistical methods used are explained and discussed.
W69-02248

METHODS OF DETERMINING SURFACE DISTRIBUTION OF EXCESSIVE RAINFALLS,
J. Petrlik.
Int Geodetic and Geophysical Union-Sec for Sci Hydrology Publ No 65 pp 303-8, 1964.

Descriptors: Rain gages, *Rainfall intensity, Surface runoff.

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Identifiers: *Calculations.

Investigation of surface distribution of heavy rainfalls in area of four largest towns in Czechoslovakia using rain gaging data of 25 yr period 1925-1949; two basic characteristics determined for rainfalls were relation between maximum intensity of total rainfall in mm/min and its duration in place of maximum intensity in minute; equation of horizontally diminishing intensity of heavy rainfalls was determined empirically.
W69-02251

COMPARISON OF SOME FORMULAS FOR DETERMINING THE SNOW MELT (PRELIMINARY RESULTS),
N. Rachner.
Wasserwirtsch-Wassertech, Vol 18, No 1, pp 10-12, Jan 1968.

Descriptors: *Snowmelt, *Runoff forecasting, *Discharge (Water), Flood control.
Identifiers: *Calculations.

Run-off forecasts, especially the snow-melt water discharge prognoses, gain continuing significance in flood prevention and water management. To present a survey of possible methods and, simultaneously, to show the order of magnitude of ommissions pertaining to the simpler methods, a selection and comparison of various formulas found in the literature is made. The statements are illustrated by examples.
W69-02252

SURFACE-WATER HYDROLOGY OF CALIFORNIA COASTAL BASINS BETWEEN SAN FRANCISCO BAY AND EEL RIVER,
S. E. Rantz, and T. H. Thompson.
U S Geol Survey-Water Supply Paper 1851, 1967. 60 pp, map.

Descriptors: *Surface runoff, Planning.
Identifiers: California.

Hydrologic information for use in project planning by California Department of Water Resources and other water agencies operating in State; study of runoff regimen indicates that, for any stream, there is close relationship between flow-duration curve and frequency curves for low flows of various durations; magnitude and frequency of high flows, for durations ranging from 1 day to 274 days, were analyzed by method that closely paralleled that used in flood-frequency study.
W69-02253

LONG-RANGE FORECAST OF CRITICAL DATES OF SPRING DISCHARGE HYDROGRAPH FROM LOCAL INDICES OF ATMOSPHERIC CIRCULATION,
M. V. Rudometov.
Am Geophysical Union. Soviet Hydrology-Selected Papers, No 1, pp 31-46, 1964.

Descriptors: *Runoff forecasting, *Flood forecasting, *Hydrographs, Discharge (Water).
Identifiers: Russia.

Methods of long-range forecasting of dates of beginning of spring high water and dates of onset of maximum discharge based on use of local indices of atmospheric circulation, taking Desna River at city of Chernigov in Ukraine as example.
W69-02256

MAGNITUDE AND FREQUENCY OF STORM RUNOFF IN SOUTHEASTERN LOUISIANA AND SOUTHWESTERN MISSISSIPPI,
V. B. Sauer.
U S Geol Survey-Prof Paper 501-D, pp 182-4, 1964.

Descriptors: *Storm runoff, Storms, Discharge (Water).
Identifiers: *Calculations.

Graphical correlations indicate that mean annual, or 2.33-yr, storm runoff for any site in area is 64 sec-ft-days/sq mi, which is equivalent to uniform depth of 2.38 in.; recurrence interval of individual storm runoff will, in many instances, be significantly different from recurrence interval of peak discharge resulting from same storm.
W69-02257

SYNTHESIS OF INLET HYDROGRAPH,
J. C. Schaake, Jr.
Johns Hopkins Univ-Dept Sanit Eng and Water Resources-Tech Report 3, June 1965. 105 p.

Descriptors: *Hydrographs, *Intakes, *Surface runoff, Storms, *Computer programs, *Drainage systems.
Identifiers: Calculations, Surface permeability.

Method is presented for synthesizing hydrograph of runoff from paved portions of drainage area; method involves application of equations of gradually varied unsteady flow in open channels to describe mechanics of surface runoff; method of synthesizing inlet hydrograph will provide means for developing records of runoff for inlet areas of sufficient length to have statistical significance; advantage of method is that drainage area behavior can be simulated on computer so response of area to arbitrary or spatially varied rainfall can be accurately predicted.
W69-02258

EXPERIMENTAL EXAMINATION OF RATIONAL METHOD,
J. C. Schaake, Jr., J. C. Geyer, and J. W. Knapp.
ASCE Proc, J Hydraulics Div, Vol 93, No HY 6, paper 5607, pp 353-70, Nov 1967.

Descriptors: *Rainfall-runoff relationships, Drainage, Runoff, *Rainfall intensity, Storm runoff, Design.
Identifiers: *Calculations, *Urban drainage, Baltimore (Md.).

Rainfall and runoff data collected in Baltimore, Md, from 20 gaged urban drainage areas ranging in size up to 150 acres have been used in study of Rational Method; results suggest that frequency of occurrence of computed design peak runoff is same as frequency of occurrence of rainfall intensity selected by designer with appropriate C; in accordance with their usual design procedures, five storm drainage designers used Rational Method to estimate 5 yr design peak runoff rates for six gaged drainage areas; these values are compared with runoff values from runoff frequency curves for these gaged areas.
W69-02259

USE OF ANALOG MODELS IN ANALYSIS OF FLOOD RUNOFF,
J. Shen.
U S Geol Survey-Prof Paper 506-A, 1965. 24 p.

Descriptors: *Computer programs, *Flood forecasting, Runoff.

Quasi-linear analog model has been developed for simulating runoff-producing characteristics of drainage system; where storage is linear unique relationship correlating inflow and outflow peaks is derived; technique for synthesizing flood-frequency distribution is also proposed, whereby effects of linear- or nonlinear-basin system upon its inflow probability distributions are examined.
W69-02261

NON-LINEAR INSTANTANEOUS UNIT-HYDROGRAPH THEORY,
K. P. Singh.
ASCE Proc, J Hydr Div, Vol 90, No HY2, Paper No 3852 pp 313-347, 1964.

Descriptors: *Hydrographs, *Storms, *Surface runoff.
Identifiers: *Calculations.

A theory has been developed, using a non-linear approach, to account for the apparent variations in instantaneous unit hydrographs derived from different storms over a given drainage basin. Excess rainfall with a non-uniform areal and time distribution is transformed to a direct surface run-off hydrograph at the basin outlet, with consideration of the effect of both overland and channel flows. The characteristics of such flows vary from place to place in any drainage basin, and their effects on the instantaneous unit hydrograph are considered in terms of the translation and storage factors of these flows over the basin. Analyses of storms over 6 drainage basins gave consistent results, indicating that the proposed equation can be used satisfactorily for instantaneous unit hydrographs.
W69-02262

BASIC GEOGRAPHICAL AND HYDROCHEMICAL CHARACTERISTICS OF LOCAL RUNOFF OF NATURAL ZONES IN EUROPEAN TERRITORY OF U S S R,
B. G. Skakal'skiy.
Soviet Hydrology-Selected Papers, No 4, pp 389-434, 1966.

Descriptors: *Precipitation, *Surface runoff, Groundwater, *Hydrographs, Discharge (Water).
Identifiers: Russia.

Consideration is given to physiographic conditions of formation from atmospheric precipitation, falling on surface of catchments, of waters of various origin that make up local runoff; volumes of waters of various origin (surface-slope, soil-surface, topsoil-ground and ground-water) are determined by genetic separation of discharge hydrographs of small rivers; on basis of material thus obtained, quantitative description is given of genetic categories of runoff developing in specific hydrologic periods on small catchments for year of average hydrometeorological conditions, and their zonal features are established.
W69-02264

PERCOLATION, GROUND-WATER DISCHARGE, AND STREAM FLOW IN THE NIDD VALLEY,
K. J. Smith.
J Instn Water Engrs, Vol 20, pp 459-471, 1966.

Descriptors: *Groundwater, *Discharge (Water), Drainage, Rain, *Runoff, *Rainfall-runoff relationships.
Identifiers: Calculations, Surface permeability.

Records of drainage, taken from a percolation gauge at Harlow Hill, near Harrogate, Yorks., were compared with values for stream flow, rainfall and run-off in the Nidd valley, Yorks., at 2 catchment areas, Hunsingore and Howstean. It was found that the response of percolation to rainfall was similar to that of run-off to rainfall, and this was particularly marked if mean values were taken over a long period. Statistical analysis showed that the relation between run-off and measured drainage was closest during winter and autumn, with correlation coefficients of 0.87 and 0.86 respectively; on the other hand there was a large discrepancy between infiltration at Hunsingore and measured drainage at Harlow Hill. It was concluded that the percolation gauge is not a satisfactory instrument for measuring effective infiltration and that results obtained from it should be compared with run-off characteristics when the gathering grounds are relatively impermeable.
W69-02265

NOMOGRAMS FOR THE DETERMINATION OF ANTICIPATED WATER DISCHARGE IN PLANNING RAIN RUN-OFF SYSTEMS,
A. N. Sorokin.
Vodosn Sanit Tekh, No 5, pp 12-14, 1960.

Descriptors: *Runoff forecasting, *Design.
Identifiers: Calculations, *Storm sewers.

Equations and nomograms are given for estimating the amount of run-off to be allowed for when designing storm-water sewers.
W69-02268

RELATIONSHIP BETWEEN SURFACE AND UNDERGROUND WATERS AND USE OF WELL OBSERVATIONS IN RIVER-FLOW FORECASTING,
A. I. Subbotin.
Int Geodetic and Geophysical Union-Sec for Sci Hydrology Publ No 63, pp 513-19, 1964.

Descriptors: *Surface runoff, *Subsurface runoff, Discharge (Water), *Rainfall-runoff relationships.
Identifiers: Russia.

Analysis of relations between groundwater level and low-water flow or minimum discharge on several Russian rivers; storm runoff-rainfall relationships.
W69-02270

HYDROLOGIC RECONNAISSANCE OF POINT REYES NATIONAL SEASHORE AREA, CALIFORNIA,
U S Geological Survey.
R. H. Dale, and S. E. Rantz.
U S Geol Surv Open-file report, 37 p, 1966. 16 fig, 9 tab.

Descriptors: *Water resources, Surface waters, *Groundwater, *National seashores, *California, Hydrogeology, Water wells, Streamflow, Water quality, Springs, Water yield, Water demand.
Identifiers: Point Reyes National Seashore.

The water resources of Point Reyes National Seashore were investigated to appraise sources of water supply at park sites where visitor accommodations are proposed. Point Reyes is a peninsula on the California coast 50 mi N of San Francisco. Its altitude ranges from sea level to 1,400 ft. Precipitation is seasonal; 75% of the 20-40 in. is in Nov through March. Runoff ranges from 6-16 in. About 90% of the runoff is in Dec through April when demand is at its minimum. Summer streamflow is inadequate at beaches in the northern part of the area and adequate at all other proposed visitor centers. Small groundwater supplies less than 25 gpm, can be developed at most sites from terrace sand and gravel deposits. The quality is generally good but iron content maybe high enough to cause problems. (Knapp-USGS)
W69-02279

QUALITY OF SURFACE WATERS OF THE UNITED STATES 1960--PARTS 7 AND 8: LOWER MISSISSIPPI RIVER BASIN AND WESTERN GULF OF MEXICO BASINS.
U. S. Geological Survey.

U S Geol Surv Water-Supply Pap 1744, 548 p, 1968. 1 fig, 33 ref.

Descriptors: *Data collections, *Surface waters, *Water quality, *Mississippi River Basin, Discharge (Water), Hardness (Water), Dissolved solids, Suspended load, Conductivity.
Identifiers: Gulf of Mexico River Basins.

The surface water quality data of the Lower Mississippi River Basin and the Western Gulf of Mexico Basins for 1960 are tabulated. The records are arranged by drainage basins in downstream order. Daily and monthly samples were collected at 178 of 195 stations for chemical analysis. Temperature was measured daily at 103 stations. Suspended sediments were measured at 22 stations. Chemical analysis reports include station location, drainage area, available records, extremes, dates of collection, discharge, concentrations of silica, Fe, Cd, Mg, Na, K, Bicarbonate, carbonate, sulfate, Cl, F, Nitrate, B, Total solids, hardness, SAR, conductance, and pH. (Knapp-USGS)
W69-02295

WATER-RESOURCES APPRAISAL OF MESQUITE-IVANPAH VALLEY AREA, NEVADA AND CALIFORNIA,
U. S. Geological Survey, Carson City, Nev., Water Resources Div.
Patrick A. Glancy.
Nev Dep of Conserv and Natur Resources, Water Resources - Reconnaissance Serv Rep 46, 57 p, June 1968. 2 fig, 1 plate, 2 photo, 18 tab, 34 ref.

Descriptors: *Water resources, *Groundwater, *Nevada, Surface waters, Aquifers, Water yield, Rainfall, Recharge, Discharge (Water), Evapotranspiration.
Identifiers: Mesquite-Ivanpah Valleys (Nevada).

A reconnaissance survey was made of the Mesquite-Ivanpah Valley area which includes 4 valleys in southern Nevada with a total area of about 830 sq mi. All the groundwater recharge is from precipitation. Total runoff is estimated to be 2,100 acre-ft per year. Estimated annual precipitation is 430,000 acre-ft and recharge is 3,100 acre-ft, less than 1% of precipitation. The known and developed aquifers are in the valley fill alluvium but abundant carbonate rocks are probably a significant aquifer system. Discharge in Mesquite Valley is by evapotranspiration but in the other valleys it is apparently by subsurface outflow. Water quality ranges from good near recharge areas to very poor near discharge areas and at great depth. Present use in Mesquite Valley is about half the estimated perennial yield and in the other valleys it is less than 10% of estimated perennial yield. (Knapp-USGS)
W69-02340

EFFECT OF DROUGHT ON STREAM QUALITY IN NEW JERSEY,
U. S. Geological Survey, Trenton, New Jersey.
Peter W. Anderson, and John E. McCall.
ASCE Proc, J Sanit Eng Div, Vol 94, No SA 5, Pap 6138, pp 779-788, Oct 1968. 10 p, 8 fig, 1 tab, 7 ref.

Descriptors: *Droughts, *Water quality, *Surface waters, *New Jersey, Streamflow, Biochemical oxygen demand, Turbidity, Dissolved solids, Dissolved oxygen, Saline water intrusion.
Identifiers: *Drought effects, Tidal-saline invasions, Delaware estuary.

The drought of 1961-1966 was studied to learn its effect on water quality in New Jersey streams. The cumulative departures of precipitation and streamflow and use of 12-month moving average analysis of water quality information showed a definite relation of water quality to water deficiency. Abnormally high dissolved solids contents, coliform bacteria counts and BOD occurred as well as abnormally low dissolved oxygen and suspended sediment content and further than usual intrusion of saline water into estuaries. The maximum effect of drought was observed in late 1965 and early 1966. Some effects, such as low streamflow, were still observable a year after the drought ended. (Knapp-USGS)
W69-02352

THE EFFECTS OF URBANIZATION ON UNIT HYDROGRAPHS FOR SMALL WATERSHEDS, HOUSTON, TEXAS, 1964-67,
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-02354

FLOW OF THE RIO GRANDE AND RELATED DATA - FROM ELEPHANT BUTTE DAM, NEW MEXICO TO THE GULF OF MEXICO - 1966.
International Boundary and Water Commission, U. S. and Mexico.

Int Boundary and Water Comm, U S and Mex, Water Bull No 36, 155 p, 1967. 2 map.

Descriptors: *Data collections, *Surface waters, *Discharge (Water), *Water quality, *Rio Grande, Gaging stations, Reservoirs, Irrigation.
Identifiers: International Boundary and Water Commission (U S-Mexico).

Stream discharges and related data of the international part of the Rio Grande are presented. The streamflow data tabulated include gaging station description, period of record, descriptions of man-made changes in flow affecting the river near each station, mean daily discharge, and calculated extreme and average flow for the year and the period of record at each station. Diversions and stored water records are listed. Chemical quality data include suspended silt, chemical analyses, electrical conductivity, salt load, and sanitary aspects of quality. Climatological data listed include rainfall in the Rio Grande Basin, rainfall on subdivisions of the basin, location of rainfall stations, evaporation, temperature, humidity, wind, basin area above each gaging stations, and irrigated areas influencing streamflow at each gaging station. (Knapp-USGS)
W69-02355

EFFECTS OF CYCLONE BEULAH ON THE YUCATAN PENINSULA (SPANISH),
Edmundo Hernandez Serrano.
Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 181-188, 1968. 8 p, 1 map, 12 photo.

Descriptors: *Floods, *Hurricanes, *Tropical cyclones, *Flood damage, *Economic impact, Storm runoff, Precipitation excess, Winds.
Identifiers: *Mexico, *Yucatan Peninsula, *Cyclone Beulah.

Some lasting effects of tropical cyclone Beulah in Mexico are reported. The second tropical disturbance formed in the Atlantic in 1967, Beulah, entered the Yucatan Peninsula the evening of September 16 with winds of 180 kph and torrential rains. The hurricane destroyed 90% of the rural dwellings on the Peninsula, crops valued at 50 million pesos and other agricultural facilities amounting to 15-1/2 million pesos, in addition to destroying or damaging livestock and forests. Fishing activities were disrupted for over 30 days resulting in losses to the economy of 5 million pesos. Total inhabitants suffering from Beulah's effects reached 17,000 in urban areas and 60,000 in rural areas. (Llaverias-USGS)
W69-02359

FLOODS CAUSED BY CYCLONE BEULAH (SPANISH).

Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 203-212, 1968. 10 p, 17 photo, 2 maps.

Descriptors: *Hurricanes, *Tropical cyclones, *Floods, Diversion structures, Watershed management, Flood damage, Flood control, Routing, Hydraulic structures.
Identifiers: *Lower Bravo River Basin, *Cyclone Beulah, *Mexico, Hurricanes.

A summary is given of the report prepared by the special Commission appointed to collect damage data from the Beulah hurricane, especially flood damage to hydraulic structures on the lower San Juan and Bravo Rivers. The freshet peak of the Alamo reached the Bravo River on Sept 22, 1967, with a flow volume of 2,500 cu m/sec. Flow of the San Juan River was regulated by incorporating the excess water at the retention reservoir of the Gomez Dam. A maximum discharge of 4,910 cu m/sec flowed through the spillway. Overflows of the San Juan River produced flooding of the Irrigation District of the Lower San Juan and the town of Camargo. Water diversions at 3 points aided in flood control at Progreso. Water from Progreso reached San Raefael where it was diverted through the relief canals from 900 to 1,000 cu m/sec toward the Culebron retention reservoir. Three cuts to release water were made downstream from San Rafael. The top of the flood continued to Matamoros with a maximum flow volume of only 445 cu m/sec. From experience gained with Beulah, it is considered possible to control similar

floods more effectively with proper utilization of retention reservoirs and controls. Recommendations are made by the Commission for projects to be planned by the International Commission for Limits and Waters. (Llaverias-USGS)
W69-02361

END OF CYCLONE BEULAH, MEXICO (SPANISH),
Jenaro Paz Reyes.
Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 189-194, 1968. 6 p, 4 graphs, 1 map.

Descriptors: *Hurricanes, *Tropical cyclones, *Flood damage, Flow control, Dams, Precipitation excess, Hydrographs, Texas, Tornadoes, Hydraulic structures, Winds.
Identifiers: *Mexico, *Cyclone Beulah, Rio Grande Basin, Mission Relief Canal, Anzalduas dam.

Cyclone Beulah, classified as the third most destructive hurricane in Texas, passed between Nueon Laredo and the Falcon Dam leaving floods in a wide zone across the Rio Grande basin and adjacent areas in Mexico and Texas in September 1967. In generating 85 tornadoes, it broke all records. The strong winds and tides caused great damage, but the torrential rains were the most devastating aspect of the storm which caused floods in all streams and rivers in Texas, south of San Antonio, and in Mexico, North of Monterrey. Flow volumes varied in the Bravo River (Rio Grande) from 6,225 cu m/sec at Fort Ringgold, Texas, to 400 cu m/sec at the gaging station below Brownsville. Relief basins in Mexico and the United States were used to obtain this reduction. The Mission Relief Canal in the U S helped divert the turbulent waters from the Lower Bravo River. The international Anzalduas Dam was also used to lower the water level and reduce flooding hazards for several cities along the lower reaches of the Rio Grande. (Llaverias-USGS)
W69-02364

WATER RESOURCES DATA FOR ALABAMA, 1967--PART 1: SURFACE WATER RECORDS.
U. S. Geological Survey, University, Ala., Water Resources Div.

Water Resources Div, U S Geol Surv, Part 1, 164 p, 1967. 2 fig.

Descriptors: *Data collections, *Surface waters, *Alabama, Discharge (Water), Gaging stations.
Identifiers: Periodic observations.

Surface-water records for the water year ending Sept 30, 1967, for gaging stations, partial-record stations, and miscellaneous sites in Alabama are compiled. Each record included location, drainage area, records available, type and history of gages, average discharge, extremes of discharge, and general remarks as well as the daily record of mean gage height, monthly summary discharge, maximum and minimum daily discharge, and yearly summary. (Knapp-USGS)
W69-02365

DISPERSION PREDICTIONS IN NATURAL STREAMS,
U. S. Geological Survey and California Univ., Berkeley.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02368

THE EFFECT OF REDUCTION IN STREAM FLOW ON INVERTEBRATE DRIFT,
Idaho State Univ., Pocatello, Dept. of Biology.
G. Wayne Minshall, and Parley V. Winger.
Ecology, Vol 49, No 3, Late Spring, 1968. 3 p, 1 tab, 12 ref.

Descriptors: *Streamflow, *Benthic fauna, *Aquatic drift, Streams, Management, Midges, Mayflies, Invertebrates, Idaho, Indicator organisms, Caddisflies, Stoneflies.
Identifiers: Stream management, Experimental design, Targhee National Forest, Stratiomyidae, Limnephilidae, Black flies, Simulium, Baetis, Ameletus, Cinygmula, Ephemerella, Spring Run Creek, Trichoptera, Dugesia, Neothremma, Dixa, Pericoma, Rhyacophila, Nemoura.

Artificial reduction of discharge of Spring Run Creek (Targhee National Forest, Idaho), to 25% of initial depth and to 44-68% of initial velocity, resulted in increases in numbers of benthic invertebrates in the drift. Forms represented included midges (Chironomidae), several genera of mayflies (Baetis, Ameletus, Cinygmula, Ephemerella), black fly larvae (Simulium), and caddisfly larvae (family: Limnephilidae). A noteworthy observation was the appearance in the drift of large numbers of the triclad flatworm Dugesia, a species not commonly found among drift organisms. Exceptions to the trend of increased numbers with reduced flow occurred in only a few taxa. Changes in current velocity and depth in the stream apparently reversed normal avoidance responses by the benthic organisms to light, and, in many instances, they entered the drift in an active and directed manner as a result of their altered behavioral patterns. Author discusses importance of these data for stream management practices and for consideration of experimental design in studying drift.
W69-02372

2F. Groundwater

HYDROLOGIC RECONNAISSANCE OF POINT REYES NATIONAL SEASHORE AREA, CALIFORNIA,
U S Geological Survey.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02279

GEOCHEMICAL STUDY OF GROUND WATERS IN THE MATSUSHIRO AREA--PART 2: CHEMICAL COMPOSITION OF GROUND WATERS,
Kyoto Univ., Kyoto, Japan, Disaster Prevention Research Institute.
Yasushi Kitano, Ryuma Yoshioka, and Setsuo Okuda.
Bull of Disaster Prev Res Inst, Vol 18, Part 1, No 132, pp 49-58, July 1968. 10 p, 7 fig, 8 ref.

Descriptors: *Groundwater, *Water quality, *Water yield, *Springs, *Earthquakes, Landslides, Calcium, Chlorides.
Identifiers: Japan.

A hydrological and chemical study of groundwater in the Matsushiro area, Japan, was made in 1966-1968 to learn the relationships between earthquake activity and groundwater quality and movement. Several large springs started flowing after the 1966 earthquakes. Some later stopped but several are still flowing. Increases in spring discharge do not follow precipitation increases, probably because the spring sources are deep. Calcium and chloride concentrations increase with earthquake activity. Discharge hydrographs of the major springs are included. Concentrations of the major ions are plotted against time. (Knapp-USGS)
W69-02286

GROUND-WATER HYDROLOGY AND GEOLOGY OF THE LOWER GREAT MIAMI RIVER VALLEY OHIO,
U. S. Geologocal Survey.
Andrew M. Spieker.
U S Geol Surv Prof Pop 605-A, pp A1-A37, 1968. 8 fig, 2 plate, 10 tab, 47 ref.

Descriptors: *Groundwater, *Induced infiltration, *Glacial drift, *Ohio, Water pollution, Water yield, Water quality, Water wells, Water level fluctuations, Water sources, Hydrogeology.
Identifiers: Great Miami River, Hamilton (Ohio), Dayton.

The groundwater resources and geology of the Lower Great Miami Valley, Ohio, were studied to determine their adequacy to meet projected population and industrial needs. The valley is one of the most productive sources of groundwater in the U. S. A buried valley averaging 2 mi wide and 150-200 ft deep, filled with permeable sand and gravel Pleistocene outwash, follows the present course of the Great Miami River. The most favorable groundwater development areas are where 150 or more ft of sand and gravel with no clay layers are recharged at rates of 400,000 gpd per acre or more by induced infiltration. Yields may be as high as 3,000 gpm. Sewage return to the stream keeps streamflow high where induced infiltration would otherwise lessen it, and makes possible continued high pumping rates which are limited mainly by increased cost of treating water of deteriorated quality. River discharge at Hamilton exceeds 490 cfs 90% of the time; ample water is available for induced infiltration. Pumpage, mostly near the area's larger cities, totaled 110 mgd in 1964. Most of the groundwater of the area is untapped. Water levels are 30-50 ft below the surface and fluctuate 5-15 ft annually with highs in winter and spring. The groundwater is hard with total dissolved solids of 400-450 mg/1. The river is contaminated by organic and industrial wastes. Groundwater contamination is not yet a problem. (Knapp-USGS)
W69-02337

QUATERNARY AQUIFERS IN THE MISSISSIPPI EMBAYMENT,
U. S. Geological Survey.
E. H. Boswell, E. M. Cushing, and R. L. Hosman.
U S Geol Surv Prof Pop 448-E, pp E1-E15, 1968. 15 p, 8 fig, 2 plate, 5 tab, 60 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Quaternary period, *Gulf Coastal Plain, Mississippi River Basin, Water yield, Water quality, Water utilization, Aquifer characteristics, Water levels, Water level fluctuations.
Identifiers: Mississippi Embayment.

Alluvial deposits of Quaternary age form one of the most productive groundwater reservoirs in an area of about 45,000 sq mi in the Mississippi embayment. Also hydrologically important is the Red River Valley alluvial aquifer in Arkansas, Louisiana, and Texas. The alluvial aquifers are desirable sources of water for irrigation and industry. They are used for public supplies only where an ample supply of water of better quality is not available from deeper aquifers. Water from the alluvial aquifers is generally a hard to very hard calcium bicarbonate or calcium magnesium bicarbonate type containing excessive iron. Water temperature ranges from 59 deg F in the northern part of the embayment to 68 deg F in the southern part. Most industrial and irrigation wells are less than 150 ft deep. Wells yielding 500 gpm or more are common over more than 90% of the Mississippi River alluvial plain, and yields of more than 5,000 gpm have been reported. Water levels are generally less than 20 ft below the land surface. The amount of water stored in the Quaternary deposits is slightly more than 120 trillion gal. Withdrawals in 1965 averaged about 1,430 million gpd. About 85% of this amount was seasonal pumpage for irrigation. Water level declines of 20-30 ft are usual in the areas of large withdrawal but water levels generally recover to near normal each year. (Author)
W69-02338

WATER-RESOURCES APPRAISAL OF MESQUITE-IVANPAH VALLEY AREA, NEVADA AND CALIFORNIA,
U. S. Geological Survey, Carson City, Nev., Water Resources Div.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02340

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SIMPLIFICATIONS OF GROUND-WATER DATA USED FOR AN ANALOGUE OF A COASTAL AQUIFER,
Water Research Assoc., Medmenham, Buckinghamshire, England.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-02344

GROUND WATER IN THE REPUBLICAN RIVER AREA, CLOUD, JEWELL, AND REPUBLIC COUNTIES, KANSAS,
U. S. Geological Survey, Lawrence, Kansas, Water Resources Division.
Stuart W. Fader.
Kans State Geol Surv Bull 188, 27 p, 1968. 14 fig, 4 plate, 3 tab, 23 ref.

Descriptors: *Water resources, *Groundwater, *Kansas, Irrigation, Alluvium, Water wells, Water yield, Water utilization, Saline water, Municipal water, Domestic water, Stock water, Transmissivity, Permeability, Aquifers.
Identifiers: Water availability, Republican River, Cloud County (Kansas), Jewell County (Kansas), Republic County (Kansas).

The groundwater resources of the Republican River area in Cloud, Jewell, and Republic Counties, Kansas, are described. Information is presented on the interrelationship between river and ground waters, the chloride content of the water and its areal pattern, and water-level fluctuations. Because surface water as well as groundwater is used for irrigation in the area, high water levels are found in some irrigated upland areas. In the lower areas, wells in alluvial deposits yield as much as 1,400 gpm. The annual pumpage in the area is about 12,300 acre-ft. Induced recharge from the Republican River is estimated to account for 710 acre-ft. Recharge from precipitation is estimated to be 0.6 in. Losses to evapotranspiration are estimated to be less than 0.2 in. In parts of northern Cloud County, chlorides may make groundwater unfit for irrigation. There is little yearly change in salinity, which is as high as 13,750 ppm in 1 well. Depth to water, contours on the water table, well locations, saturated thickness, and areas of salinity high enough to be dangerous for irrigation are mapped. Permeabilities and transmissibilities were estimated from pumping tests. Hydrographs of observation wells and the Republican River are included. (Knapp-USGS)
W69-02345

PERMEABILITY OF SAND WITH DISPERSED CLAY PARTICLES,
Mississippi State Univ., State College.
Keith H. Denson, Adnan Shindala, and Charles D. Fenn.
Water Resources Res, Vol 4, No 6, pp 1275-1276, Dec 1968. 2 p, 1 fig, 2 tab.

Descriptors: *Permeability, *Sands, *Kalinite, *Montmorillonite, *Laboratory tests.

Experiments on sand containing varying amounts of montmorillonite and kaolinite show that contents of montmorillonite over 3% reduce effective permeability to water by 100% for sands with a grain size distribution with a mean of 0.30 mm and standard deviation of 0.18 mm. Kaolinite over 16% reduces the permeability of similar sands to practically 0. Losses of permeability of the sand samples with clay contents of 0-10% are tabulated. Permeability of the pure sand used is 0.1082 cm/sec. Only 1% montmorillonite is needed to reduce permeability by 82%. (Knapp-USGS)
W69-02347

A MATHEMATICAL MODEL FOR TRANSIENT FREE SURFACE FLOW IN NONHOMOGENEOUS OR ANISTROPHIC POROUS MEDIA,
Acres Ltd., Niagara Falls, Canada.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-02353

ELECTRIC-ANALOG STUDIES OF BRINE CONING BENEATH FRESH-WATER WELLS IN THE PUNJAB REGION, WEST PAKISTAN,
U. S. Geological Survey.
G. D. Bennett, M. J. Mundorff, and S. Amjad Hussain.
U S Geol Surv Prof Pop 1608-J, pp J1-J31, 1968. 31 p, 12 fig, 1 plate, 1 tab, 5 ref.

Descriptors: *Saline water-freshwater interfaces, *Saline water intrusion, *Pumping, Water pollution sources, Analog models.
Identifiers: Punjab (West Pakistan), Skimming wells.

A graphical procedure developed to deal with the problem of water coning beneath an oil well was used to study the coning of saline water beneath a fresh-water well with uniform areal recharge. The head distribution employed in this technique was from an analog model for steady-state axisymmetrical flow. Through a technique of successive approximation, the lower boundary of the model was adjusted to simulate the highest stable position of the brine cone in each of 18 different experiments. Flownets were constructed from the analog results for each experiment. The series of experiments represented 6 screen penetrations at each of 3 values of a parameter representing the thickness of fresh water at the radius of influence of the well, the lateral permeability, and the vertical permeability. Dimensionless functions yielding the drawdown and discharge of the well when the brine cone is in its highest stable position were calculated from the results of each experiment. Applied to conditions in the Pinjab Region of West Pakistan, the results indicate that prospects are good for the development of wells capable of yielding fresh water above a stable cone in the underlying brine or brackish water. (Author)
W69-02362

2G. Water in Soils

SOIL WATER RECHARGE DURING THE DORMANT PERIOD IN THE NORTHWEST CORN BELT,
Agricultural Research Service, Morris, Minn., North Central Soil Conservation Research Center.
D. R. Timmons, and R. F. Holt.
J Soil and Water Conserv, V 23, No 5, pp 177-180, Sept-Oct 1968. 4 p, 5 fig, 2 tab, 12 ref.

Descriptors: *Recharge, *Soil moisture, *Prairie soils, South Dakota (Minnesota).
Identifiers: Dormant season (Crops), Farming.

Soil water recharge during the dormant period was measured for several crops at 17 locations in western Minnosota and eastern South Dakota during a 3-yr period. The experimental areas were on prairie soils developed on calcareous glacial till or on loess overlying till. Annual precipitation is 21-25 inches, of which 10-12 are available for recharge. Soil watercontent at the beginning of the dormant period is a major factor in determining dormant season recharge. The greatest increase in total soil water generally was in late March and early April when precipitation was rain and wet snow and the soil was thawing. Between freeze and thaw, 49% of precipitation was retained by the soil. Spring recharge was 29% of precipitation, and was lowest where initial soil moisture was highest. (Knapp-USGS)
W69-02284

STRUCTURAL ALTERATION OF SOIL SURFACES BY TILLAGE AND RAINFALL,
Agricultural Research Service, Morris, Minnesota.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-02377

DETERMINATION OF HYDRAULIC CONDUCTIVITY AS A FUNCTION OF DEPTH AND WATER CONTENT FOR SOIL IN SITU,
CSIRO, Canberra, Div. Land Res. and Reg. Surv., and Australian Nat. Univ. School of General Studies, Dept. of Math.
C. W. Rose, W. R. Stern, and J. E. Drummond.
Australian J Soil Res, Vol 3, No 1, pp 1-9, July 1965. 9 p, 4 fig, 19 ref.

Descriptors: *Hydraulic conductivity, *Moisture content, Radiation, *Saturated soils, *Soil profiles, *Depth, Soil moisture, Soil water movement, Overburden, Measurement, Hysteresis, Equations, Temperature.
Identifiers: In situ soil, Unsaturated soils, Suction, Vapor.

The paper shows how hydraulic conductivity may be determined in the field over the entire range of water contents on a soil of non-uniform profile. A theory is presented to calculate hydraulic conductivity as a function of depth and successive measurements of water content profiles for soils in situ. With unsaturated soil, potential gradients are inferred using moisture characteristics. With saturated soil potential gradients must be measured directly. Correction due to the overburden effect should be checked whenever in situ soil water suction is inferred from water content via soil moisture characteristics. A possible limitation to the method, particularly if radiation is intense such as in arid climate, might be the effect of daily temperature waves on water redistribution in either liquid or vapor phase. This effect will usually be restricted to the top 20 cm. of the soil profile. (Blecker-Ariz)
W69-02380

WATER MOVEMENT ABOVE SHALLOW WATER TABLES IN SOUTHERN ALBERTA,
Canada Department of Agric., Lethbridge, Alberta, Research Station.
J. C. Van Schaik, and D. S. Stevenson.
J Hydrol - Amsterdam, Vol 5, No 2, pp 179-186, 1967. 8 pp, 1 fig, 2 tab.

Descriptors: *Water table, *Soil surfaces, *Evaporation, *Saline soils, Soil moisture, *Soil water movement, Groundwater, Arid lands, Rainfall, Precipitation intensity, Lysimeters, Soil temperature, Water loss, Siphons, Clay loam, Water balance, Seasonal.
Identifiers: *Salt accumulation, Alberta (Canada).

Water movement was measured under bare soil with a shallow water table (3-5 feet from the surface) in southern Alberta. Where rainfall from June 1 to November totaled 15 cm. or more, a net downward movement of water could be expected under bare clay loam if the water table was at a depth greater than 1 meter. A net annual upward movement could be expected when the water table is at a depth of less than 1 meter. Under these circumstances water migration during the winter and subsequent evaporation in the spring could add to the salt accumulation at the soil surface. Results indicated that the low evaporation from the water supplied by the groundwater explained the lack of salt accumulation at the soil surface at the study site. The soil and climate conditions that were studied are common in the arid parts of the world. (Blecker-Ariz)
W69-02381

ADSORPTION OF SODIUM FROM IRRIGATION WATER BY FOUR TEXAS SOILS,
Texas A and M Univ., College Station.
Grant W. Thomas, and Bruno Yaron.
Soil Sci. Vol 106, No 3, pp 213-219. September 1968. 7 p, 4 tab, 6 fig.

Descriptors: *Sodium, Alkaline water, *adsorption, Saline water, *Soil chemistry, Leaching, Electrolytes, Chromatography, Equilibrium, Mineralogy, *Irrigation water, *Cation exchange, Clay minerals, Flow rates, Texas, Hydraulic conductivity.

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Identifiers: *Soil columns.

The adsorption of sodium from saline water during flow through chromatographic columns was studied utilizing four soil types from Texas having different soil mineralogy texture and cation exchange capacity. Eight synthetic and two natural well waters were used to leach the soils. It was concluded that the relationship between SAR and ESP of soil did not give a significant correlation when sodium containing water flowed through soil columns. The exception was the surace of the soil. The total electrolyte concentration of the sodic water influenced the rate of sodium adsorption. At equilibrium soil mineralogy and the cationic composition exerted a greater influence over the exchangeable sodium percentages. Mica and montmorillonitic soils had a greater affinity for Na than did montmorillonitic soils. Flow of water in field conditions from equilibrium hydraulic conductivity could not be determined. (Affleck-Ariz)
W69-02390

2H. Lakes

RELATIVE RIPARIAN OR LITTORAL RIGHTS RESPECTING THE REMOVAL OF WATER FROM A NATURAL, PRIVATE, NON-NAVIGABLE LAKE,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02008

OBRECHT V NATIONAL GYPSUM CO (RIPARIAN RIGHTS IN GREAT LAKES).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02019

VILLAGE OF CHESTER V KANTOD PARK ASSOC, INC (WITHDRAWAL OF WATER FROM LAKE).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02022

QUALITY OF WATER AND STRATIFICATION OF POSSUM KINGDOM, WHITNEY, HUBBARD CREEK, PROCTOR AND BELTON RESERVOIRS,
Texas Water Development Board, Austin.
Donald K. Leifeste, and Barney Popkin.
Tex Water Develop Board Rep 85, 116 p, Oct 1968. 16 fig, 5 tab, 18 ref.

Descriptors: *Chemical stratification, *Density stratification, *Reservoirs, *Texas, Limnology, Chlorides, Dissolved solids, Water quality, Water temperature.
Identifiers: Brazos River Basin (Texas).

The chemical quality and stratification of Possum Kingdom, Whitney, Hubbard Creek, Proctor, and Belton Reservoirs, Texas, were studied between Sept 1961 and May 1965. The water in Possum Kingdom Reservoir generally contains between 1,050 and 1,600 ppm dissolved solids. Inflow varies considerably in salinity and is seldom similar to the water in storage. The low-flow of winter brings highly-saline water to the reservoir; the higher flows of spring usually are of much better quality. The reservoir is seasonally thermally stratified and because salinity is seasonally variable with highest values at winter low flow, the chemical stratification parallels the seasonal thermal stratification. The water in Whitney Reservoir generally contains 650 and 1,200 ppm dissolved solids. About 2/3 of the inflow is water released from Possum Kingdom Reservoir. Seasonal stratification patterns usually develop only during the winter months when local runoff is small and inflow consists mostly of releases from Possum Kingdom Reservoir. The water quality in Hubbard Creek, Proctor, and Belton reservoirs is good; generally total dissolved solids are below 500 ppm. Stratification occurs only with storm runoff in Hubbard Creek Reservoir and is usually of short duration. (Knapp-USGS)
W69-02339

CHLOROPHYLL DERIVATIVES IN SURFACE MUDS FROM THE ENGLISH LAKES,
Toronto Univ., Ontario, Canada, Dept. of Botany.
Eville Gorham.
Limnol Oceanogr, Vol 5, pp 29-33, 1960. 5 p, 2 fig, 2 tab, 7 ref.

Descriptors: *Plant pigments, *Sediment-water interfaces, *Eutrophication, *Diagenesis, Chlorophyll, Mud, Diatoms, Sedimentation, Nutrients, Oligotrophy, Limnology, Lakes, Potash, Carbon, Carbon cycle, Lime, Phytoplankton, Water pollution effects, Water pollution sources, Spectrophotometry.
Identifiers: *Chlorophyll derivatives, Pheophytin, Melosira, English Lake District, England, Wastwater, Ennerdale Water, Windermere North Basin, Esthwaite Water, Priest Pot.

Chlorophyll derivatives, total carbon, and total sulfur were estimated in surface muds from five widely differing bodies of water of the English Lake District (Wastwater, Ennerdale Water, Windermere North Basin, Esthwaite Water, Priest Pot). All three components increased in the muds of these lakes, which varied from large infertile types, low in phytoplankton and poor in lime and potash, to smaller lakes with large phytoplankton crops and more plentiful lime and potash. Carbon, expressed as percentage dry weight of mud, varied from 6.6 (Ennerdale Water) to 18.9 (Priest Pot); sulfur, similarly expressed, from 0.18 (Wastwater) to 1.22 (Priest Pot). Chlorophyll derivatives, in arbitrary units per gram of dry weight, varied between 0.21 (Wastwater) and 6.88 (Priest Pot). Ratios at particular wavelengths (410/350 millimicrons) of optical densities of acetone extracts of mud may be related to balance between autochthonous and allochthonous organic matter and to length of time they spend in an oxidizing atmosphere. That ratio for Wastwater (0.7) indicates that chlorophyll derivatives from terrestrial sources may be more important there than in Priest Pot (1.8). Author suggests that concentration of chlorophyll derivatives in mud may be more sensitive as an indicator of lake fertility than concentration of carbon or sulfur.
W69-02369

PHOSPHORUS UTILIZATION BY ASTERIONELLA FORMOSA,
Ferry House, Far Sawrey, Ambleside, Westmorland, England.
F. J. Mackereth.
J Exp Botany, Vol 4, No 12, pp 296-313, Sept 1953. 18 p, 9 fig, 6 tab, 20 ref.

Descriptors: *Diatoms, *Phosphorus compounds, *Water pollution effects, *Plant growth, Lakes, Growth rates, Population, Productivity, Algae, Cultures, Environmental effects, Nutrients, Cycling nutrients, Essential nutrients, Eutrophication, Nutrient requirements, Phytoplankton.
Identifiers: Lake Windermere, Asterionella, England.

Studies, in Lake Windermere (England), of the relationship of growth of the diatom Asterionella formosa to concentrations of dissolved phosphate occurring there and studies of phosphorus requirements for growth by that organism in culture indicate that it can take up and store reserve phosphorus from concentrations (below 1 microgram per liter) found in phosphorus-poor lakes. Population growth of diatoms continues in phosphorus-deficient media at the expense of cellular phosphorus. Limiting requirements of phosphorus per cell are minute (about 0.06 microgram per million cells). Culture experiments indicate that initial concentrations as low as 1.0 micrograms phosphorus per liter theoretically can produce some 16 million cells per liter. Growth of this diatom in nature conforms to that in culture. Author concludes that very low initial concentrations of dissolved phosphate in Windermere probably do not limit population growth of Asterionella. Cells of this species, low in phosphorus, rapidly take up added phosphorus from lake water but not from distilled water. The unknown factor in lake water, which influences phosphate uptake by depleted cells, appears to be heat labile and dependent upon pH.
W69-02371

2I. Water in Plants

THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
Minn. Univ., St. Paul, School of Forestry, and Ariz. Univ., Tucson, Dept. of Watershed Management.
J. A. Nicolson, D. B. Thorud, and E. I. Sucoff.
J Soil and Water Conservation, V 23, No 5, pp 181-184, Sept-Oct 1968. 4 p, 1 fig, 3 tab, 10 ref.

Descriptors: *Interception, *White pine trees, *Laboratory tests, *Evapotranspiration, Transpiration, Evaporation, Energy budget.
Identifiers: White spruce trees.

Interception was studied by planting 8 white spruce and 8 white pine trees, all about 3 ft high, about 6 f apart in pots in a 200 by 600 ft clearing in a fores of oak trees. Relative humidity, air temperature net radiation, evaporation, and wind velocity were measured. The trees were weighed dry to deter mine transpiration and weighed after wetting t determine interception. A relationship was deter mined between transpiration of the wetted tree and the control or unwetted group. Wetted whit spruce transpired 53 gm or 17% less than unwette trees. This was only 13% of the 405 gm of inter cepted water; 87% of the intercepted wate evaporated without affecting transpiration. Fo wetted white pine, transpiration was 42 gm or 14 less than for unwetted trees. This was 12% of th 371 gm of intercepted water. The percentage wate saved in white pine decreased as the number o wettings increased. There was no such trend i white spruce. The experimental data are tabulate (Knapp-USGS)
W69-02289

COMPARISON OF WATER POTENTIALS I LEAVES AS MEASURED BY TWO TYPES O THERMOCOUPLE PSYCHROMETER,
CSIRO, Griffith, N.S.W., Australia, Irrigatio Research Laboratory.
H. D. Barrs.
Australian J Biol Sci, Vol 18, No 1, pp 36-5 February 1965. 17 pp, 10 fig, 2 tab.

Descriptors: *Instrumentation, *Leave *Hygrometry, Heat, *Vapor pressure, Respiratio Anaerobic conditions, Aerobic conditions, Coo ing, Calibrations, Temperature, Oxygen, *Plant ti sues, Plant physiology, Metabolism, Measuremer Moisture stress.
Identifiers: *Thermocouple psychrometer, *Wat potential, Dry bulb temperature, Wet bulb te perature.

Two types of thermocouple psychrometers we compared with respect to the measuring of wat potentials in leaves. Significant differences we observed between the Spanner and the Richar and Ogata psychrometers. Differences were caus by liberation of heat accompanying aerob respiration by the tissue which raised the chamb temperature above that of the controlled wat bath in which the chamber was immersed. The t psychrometers agreed closely owing to preventi of temperature rise within the vapor pressu equilibration chambers that contained leaf mate al. This was done by attaching the leaf to a he sink in the chamber. The Spanner psychrome was found to be preferable to that of Richa when working with plant material since it takes i account the departure of chamber temperatu from bath temperature caused by metabolic acti ty, whereas a single Richards psychrometer co not. The thermocouple psychrometer could used in arid climates to measure water potentials

leaves and to indicate moisture stress in plants. (Blecker-Ariz)
W69-02375

AN APPARATUS FOR MEASURING WATER POTENTIALS IN THE XYLEM OF INTACT PLANTS,
CSIRO, Griffith, N S W, Australia, Irrig. Res. Lab.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-02378

CONTROL OF LEAF STOMATA--THEIR ROLE IN TRANSPIRATION AND PHOTOSYNTHESIS,
Israel Zelitch.
American Scientist, Vol 55, No 4, pp 472-486, 1967. 15 pp, 3 fig, 5 tab, 35 ref.

Descriptors: *Stomata, *Transpiration control, Photosynthesis, *Water vapor, *Water conservation, Hydrologic cycle, Leaves, Biochemistry, Diffusion, Plant physiology, Carbon dioxide.

Experiments concerned with the mechanism of stomatal opening and closing were described and the consequences of the biochemical control of stomatal opening on the processes of photosynthesis and transpiration were discussed. Water vapor escaping from the leaf has a shorter path length of diffusion since intercellular spaces within the leaf at the evaporating surface of the mesophyll cells are already saturated with water vapor. Narrowing of stomata in isolated leaves or plants in the laboratory decreases transpiration. Stomatal diffusive resistance is a significant factor in water conservation and control of their width may provide a strategic and rational means of achieving changes of scope in the hydrologic cycle in arid climates. (Blecker-Ariz)
W69-02379

RESISTANCE TO GAS FLOW THROUGH THE LEAF AND ITS SIGNIFICANCE TO MEASUREMENTS MADE WITH VISCOUS FLOW AND DIFFUSION POROMETERS,
Hebrew Univ of Jerusalem, Dept. of Botany.
J. Gale, and Alexandra Poljakoff-Mayber.
Israel J Bot, Vol 16, No 4, pp 205-211, 1967. 7 p, 2 fig.

Descriptors: *Resistance, *Gases, *Flow measurement, *Leaves, Measurement, Viscous flow, Pores, Diffusion, *Water vapor, Vapor pressure, Stomata, Boundary layers, Surfaces.
Identifiers: Gas flow, *Porometers, Vapor exchange, Air vapor, Air vapor density gradient.

Resistance to viscous flow of air through the leaf and resistance to diffusion of water vapor out of the two leaf surfaces were measured simultaneously while environmental conditions were varied in bean and maize leaves. The leaves were subjected to increasing degrees of leaf to air vapour deficit while still attached to well watered plants. The result of this treatment was an increase in resistance to viscous flow which was not paralleled by an increase in diffusion resistance for both species. It was concluded that porometers based on the passage of gas through the leaf may give highly erroneous estimates of leaf resistances to gas and vapour exchange. (Affleck-Ariz)
W69-02389

THE MECHANISM OF SALT TOLERANCE IN SUAEDA FRUTICOSA AND HALOXYLON RECURVUM,
Karachi Univ, Karachi, West Pakistan, Botany Dept.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-02396

GROWTH AND WATER REQUIREMENTS OF SOME RANGE PLANTS UNDER CONTROLLED CONDITIONS,
Cairo Univ, Cairo, UAR, Desert Institute, Mataria.
A. A. Abd El-Rahman, and M. O. El-Monayeri.
Plant and Soil, Vol 29, No 1, pp 119-131, Aug 1968. 13 p, 3 fig, 3 tab.

Descriptors: *Range grasses, Osmotic pressure, Moisture availability, *Plant growth, Soil moisture, Soil-water-plant relationships, Xerophytes, Wilting point, *Water requirements, *Transpiration, Deserts, *Drought resistance, Arid lands.
Identifiers: Sap, United Arab Republic.

A study of the growth, water requirements and drought resistance of five introduced and five native range plants was conducted at the Ras El-Hikma Range Research Station of the United Arab Republic. Growth aspects, transpiration rate, and sap osmotic pressure were determined at different levels of available soil moisture from permanent wilting to the moisture equivalent. The transpiration intensity of all the studied species was low and comparable with that of xerophytes living under extremely dry conditions. Most vigorous vegetative growth and highest dry matter production were shown by Chloris gayana. It was concluded that Chloris gayana was the most suitable species for cultivation in desert regions. (Affleck-Ariz)
W69-02398

2J. Erosion and Sedimentation

WYATT V WYCOUGH (ACCRETION).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02024

STATISTICAL DESCRIPTIONS OF SAND WAVES FROM STREAMBED PROFILES,
U. S. Geological Survey, Ft. Collins, Colo., Water Resources Div.
Carl F. Nordin, and Everett V. Richardson.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 25-32, Sept 1968. 8 p, 10 fig, 1 tab, 7 ref.

Descriptors: *Alluvial channels, *Dunes, *Sand waves, *Channel morphology, *Statistical methods, Mathematical models, Methodology, Streambeds, Sediments, Sounding.
Identifiers: Gaussian distributions, Streambed profiles.

Statistical treatment of profiles obtained by sonic sounding of dunes in alluvial channels show that bed elevation has approximately a Gaussian distribution, and the amplitudes of the dunes are distributed exponentially. The standard deviation of the bed elevation correlates well with the average amplitude. The mean rest period of a particle can be determined empirically and can be estimated from theoretical considerations of simple models of the dune-forming process. (Knapp-USGS)
W69-02343

2K. Chemical Processes

MOLYBDENUM AS A FACTOR LIMITING PRIMARY PRODUCTIVITY IN CASTLE LAKE, CALIFORNIA,
California Univ., Davis, Dept. of Zoology.
Charles R. Goldman.
Science, Vol 132, p 1017, 1960. 2 p, 1 fig, 9 ref.

Descriptors: *Molybdenum, *Primary productivity, *Bioassay, California, Carbon radioisotopes, Photosynthesis, Nitrogen fixation, Trace elements, Lakes, Chlovella, Scenedesmus, Cirques.
Identifiers: *Castle Lake (Calif.), Alder trees, Alnus.

Enrichment with molybdic acid or sodium molybdate of waters of Castle Lake, California, a cirque lake with restricted watershed, stimulates the rate of carbon-14 uptake by resident populations of phytoplankton both in situ and in the laboratory. Addition of molybdenum in optimum concentrations of 0.025 ppm showed qualitatively similar results throughout the year. In a typical experiment, addition of 0.10 ppm molybdenum resulted in uptake of carbon-14 (expressed as counts per minute) approximately three times greater than in unenriched controls after four days incubation. Author suggests that trace element deficiencies may be characteristic of lakes with limited watersheds. He also suggests that the effect of molybdenum deficiency in this lake is mediated via nitrogen reductase in the nitrogen fixation-reduction system and that heavy growth along the shores of alder--a nitrogen-fixing species--competes with the lake for available molybdenum.
W69-02373

2L. Estuaries

TIDEWATER TITLES CONFIRMED.

Ga Code Ann Sec 2-601 (1967).

Descriptors: *Georgia, Legislation, *Ownership of beds, *Low water mark, *Tidal waters, State jurisdiction.
Identifiers: Constitutional provisions.

The Georgia Constitution, by this provision, ratifies the 1902 Act of the General Assembly which extends the title of ownership of lands abutting on tidal water to the low water mark. (Williams-Fla)
W69-02061

THE EFFECT OF FRESH-WATER RUN-OFF ON A POPULATION OF ESTUARINE POLYCHAETOUS ANNELIDS,
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-02215

ON THE CHANGE IN SALINITY DISTRIBUTION AND BOTTOM TOPOGRAPHY AFTER THE CLOSING OF THE MOUTH OF KOJIMA BAY,
Kyoto Univ., Kyoto, Japan, Disaster Prevention Research Institute.
Setsuo Okuda.
Bull of Disaster Prev, Res Inst, Vol 18, Part 1, No 133, pp 35-48, July 1968. 14 p, 9 fig, 2 tab, 5 ref.

Descriptors: *Estuaries, *Reservoirs, *Salinity, *Saline water-freshwater interfaces, *Salt balance, Topography, Saline water intrusion, Winds, Mixing.
Identifiers: Polders (Japan).

The effects of closing of Kojima Bay, an estuary in southern Okayama Prefecture, Japan, to make a fresh-water reservoir, were studied. The salinity distribution, flow pattern, and topography of the bottom were changed. In the rivers entering the reservoir, salinity increase is approximately linear downstream. In the lake, there is a stable horizontal interface between inflowing river water and lower salt water. The position of the interface varies with riverflow, irrigation pumping, and intrusion of sea water when the gates are open. The change with gate opening averages 20-40 cm. Winds cause mixing which blurs the interface and strong drift currents which tilt it. The salt balance effect of river inflow and outflow, polder drainage, and seawater intrusion was calculated and the results are tabulated. (Knapp-USGS)
W69-02290

COOPER RIVER, SOUTH CAROLINA (SHOALING IN CHARLESTON HARBOR).
Corps. of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, Senate Doc No 88, 206 p, 1968. 3 fig, 5 plate, 5 tab, 1 suppl, 1 append.

Descriptors: *Harbors, *Sedimentation, *Density currents, Salinity, Canals, Model studies, Hydroelectric power, South Carolina.
Identifiers: Santee River, Cooper River, Charleston Harbor.

Study of the shoaling of Charleston Harbor, South Carolina, showed that shoaling increased soon after diversion of water by a hydroelectric power project from the Santee River into Cooper River and Charleston Harbor in 1942. The investigation, which included model tests, proved that the diversion caused the shoaling by interaction of increased fresh water discharge with salty harbor water and formation of bottom density currents, predominantly upstream, which prevent settled sediment from being flushed out to sea. The best remedial plan is to redivert the Santee River water back to the Santee River through a canal. A powerplant of 84,000 Kw is proposed for the canal. The existing plant would be operated at a reduced output. Total power would be increased, while discharge to the harbor would be greatly reduced. Cost is estimated to be $35,381,000. The benefit-cost ratio is estimated to be 2.17 for 50-year amortization, and for 100-year amortization, 2.73. (Knapp-USGS)
W69-02296

NUMERICAL STUDIES OF UNSTEADY DISPERSION IN ESTUARIES,
Massachusetts Institute of Technology, Cambridge, and Gibbs and Hill, Inc., Boston, Massachusetts.
Donald R. F. Harleman, Chok-Hung Lee, and Lawrence C. Hall.
ASCE Proc, J Sanit Eng Div, Vol 94, No SA 5, Pop 6160, pp 897-911, Oct 1968. 15 p, 11 fig, 9 ref.

Descriptors: *Mathematical models, *Estuaries, *Saline water intrusion, *Tides, Currents (Water), Digital computers, Tracers, Dye releases, Dispersion, Path of pollutants.
Identifiers: Finite-difference methods, Potomac River.

A one-dimensional mathematical model is developed which describes the longitudinal concentration distribution of a pollutant in an estuary. The importance of including the tidal velocity in the advective term of the mass balance equation is emphasized. The cross-sectional area, the tidal and fresh water velocities and the longitudinal dispersion coefficient may all be functions of distance and time. The unsteady equation for the concentration distribution is solved by an implicit, finite-difference technique on a digital computer. The difference in the magnitude of the longitudinal dispersion coefficient, E, in the salinity intrusion region and in the fresh water tidal portion is described. A modification of Taylor's dispersion equation is presented for the determination of E in the fresh water tidal portion of an estuary. The mathematical model is applied to the upper portion of the Potomac estuary and the results are compared with field observations for a 13-day period in which dye was injected into the estuary. The predicted concentration distributions are in reasonable agreement with the measured values. The magnitude of E is of the order of 0.1 sq mile per day. The importance of nonlinear tidal motion effects is described in relation to the distribution of pollutants in estuaries. (Author)
W69-02346

DIFFERENCE MODELING OF STREAM POLLUTION,
Oregon State Univ., Corvallis, and New York Univ., New York.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02367

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

JOINT WATER SUPPLY FACILITIES.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02017

WATER SUPPLIES AND SEWAGE DISPOSAL IN BERLIN,
K. Huhnerberg.
Gas Wasserfach, Vol 104, pp 1203-1213, 1963.

Descriptors: *Sewage treatment, *Storm runoff, *Overflow, Sedimentation.
Identifiers: *Combined sewers, Capacity, Berlin (Germany).

A detailed illustrated description is given of the sources and treatment of water supply and of sewage disposal in the area of West Berlin from the Elbe-Saale to the Oder and Neisse. Increased demands due to industrial development have necessitated extensions and reconstructions of existing water works and construction of new water works and sewage-treatment plants. The performance of the various water works is tabulated. Finally, the author discusses the advantages of combined over separate sewerage systems and the design and dimensions of sedimentation tanks and storm-water overflows.
W69-02136

ON THE CHANGE IN SALINITY DISTRIBUTION AND BOTTOM TOPOGRAPHY AFTER THE CLOSING OF THE MOUTH OF KOJIMA BAY,
Kyoto Univ., Kyoto, Japan, Disaster Prevention Research Institute.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-02290

TRENDS IN RESERVOIR CAPACITY AND USE,
U. S. Geological Survey, Washington, D. C.
W. B. Langbein.
Ind Water Eng, Vol 5, No 10, pp 30-31, Oct 1968. 2 p, 2 fig.

Descriptors: *Reservoirs, *Water users, Multiple-purpose reservoirs, Conservation, Dams, Irrigation water, Recreation, Municipal water, Industrial water, Hydroelectric power, Flood control.
Identifiers: Reservoir capacity, Water-use study.

The recent history of dam and reservoir construction and use in the U S is reviewed. There are over 1,600 reservoirs larger than 5,000 acre-ft. The growth in total reservoir capacity has been a steady 80% per decade since 1900, contrasting with a 40% increase in total water use and a 20% population growth. There have been significant changes in reservoir use. In 1900, most reservoirs were for municipal supply and power generation purposes. With passage of Federal Reclamation laws in 1902, irrigation storage increased and became the largest component of reservoir capacity in the 1920's. The flood control acts of 1936 and 1938 expanded that use until now it exceeds irrigation. The present rank is power first, flood control second, irrigation third and water supply fourth. Since the 1930's, there has been great emphasis on multiple-use reservoir size, from 60,000 acre-ft before 1933 to 370,000 acre-ft after 1950. The trend toward larger reservoirs probably will decline as most large sites are used, but reservoirs will remain an important part of American water management. (Knapp-USGS)
W69-02336

THE MECHANISM OF SALT TOLERANCE IN SUAEDA FRUTICOSA AND HALOXYLON RECURVUM,
Karachi Univ, Karachi, West Pakistan, Botany Dept.
Rafiq Ahmad.
Plant and Soil, Vol 28, No 2, pp 357-362. Apr 1968. 7 p, 2 tab.

Descriptors: *Halophytes, *Plant physiology, Salinity, Saline soils, *Salt tolerance, Alkaline soils, Toxicity, Cytological studies, Cation exchange, Sampling, Soil chemistry, Granules, X-ray spectroscopy, Irrigation effects.

Physiology of salt tolerance in plants has the attention of plant scientists because salinity and alkalinity are taking over large areas of irrigated land all over the world. A study was conducted in West Pakistan using Suaeda fruiticosa and Haloxylon recurvum to determine how the harmful effects of excess salts are offset within the plant. Free hand sections of their leaf and stem revealed the presence of intracellular granular structures in various regions of the hypodermis, cortex and pith. On analysis they were found to contain salts of Na, K, Ca, and Mg impregnated with some quartz particle which rendered them insoluble to water. It was concluded that the cells worked merely as storehouses and did not let the mineral interfere in the normal metabolism of the plant. This was considered as one of the adoptive mechanisms for inducing salt tolerance in the halophytes. (Affleck-Ariz)
W69-02396

3C. Use of Water of Impaired Quality

WASTEWATER REUSE AT THE GRAND CANYON,
Arizona State Department of Health, Phoenix.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02349

REMOTE SENSING FOR ESTIMATING SOIL SALINITY,
Agricultural Research Service, Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02385

EFFECT OF SOIL SALINITY ON EXTERNAL MORPHOLOGY OF COTTON LEAVES,
Agricultural Research Service, Weslaco, Texas.
Harold W. Gausman, and Ruben Cardenas.
Agron J, Vol 60, No 5, pp 566-567, Sept-Oct 1968. 2 p, 3 tab.

Descriptors: *Saline soils, *Plant morphology, *Leaves, Epidermis, Cytological studies, *Cotton, Plant growth, Plant physiology, *Remote sensing, Sampling, Stomata, Texas, Microscopy, Loam.
Identifiers: Leaf thickness, Rio Grande Valley, Photomicroscopy.

A study on the external morphology of leaves from cotton grown in areas of low and high soil salinity was conducted at Weslaco, Texas, in the Rio Grande Valley. The fourth leaf from the apex of each cotton plant was sampled and the thickness of each leaf was measured. Also counts on the number of stomata and epidermal cells, and measurements on their size were made. Microscopic examination revealed that high salinity caused fewer epidermal cells and stomata per unit area, increased surface size of epidermal cells, and increased leaf thickness. (Affleck-Ariz)
W69-02392

SODIUM HAZARD OF IRRIGATION WATERS AS INFLUENCED BY LEACHING FRACTION

AND BY PRECIPITATION OR SOLUTION OF CALCIUM CARBONATE,
Salinity Laboratory, Riverside, Calif.
C. A. Bower, G. Ogata, and J. M. Tucker.
Soil Sci, Vol 106, No 1, pp 29-34, July 1968. 6 p, 4 fig, 5 tab.

Descriptors: *Sodium, *Irrigation water, *Leaching, *Chemical precipitation, *Calcium carbonate, Hydrogen ion concentration, Lysimeters, Alfalfa, Salinity, Loam, Adsorption, Cation exchange, Drainage water, Calcium, Magnesium.
Identifiers: Leaching fraction, Steady state values.

Calcareous Pachappa sandy loam in lysimeters growing alfalfa was irrigated with six waters having variable Na/ (Ca + Mg) and HCO3/ (Cl = SO4) ratios at leaching fractions of .1, .2, .3, and .4, until the sodium adsorption ratio of the drainage water became constant. Increased leaching repressed precipitation of CaCO3 from the waters and enhanced solution of CaCO3 from the soil. At any leaching fraction the amount and fraction of applied HCO3 that precipitated as CaCO3 from the water or the amount of CaCO3 that dissolved from the soil was highly related to a calculated pH value of the water which was dependant primarily upon the Ca, Mg, and HCO3 concentrations of the water. When the sodium-adsorption ratio of the drainage waters from the lysimeters had become constant, the salt and exchangeable Na that had accumulated in the soil increased with depth. (Affleck-Ariz)
W69-02393

EFFECT OF SALINITY AND WATER SUPPLY ON OLIVE,
Cairo Univ, Cairo, UAR, Dept of Botany.
A. A. Abd El-Rahman, and M. H. Sharkawi.
Plant and Soil, Vol 28, No 2, pp 280-290, Apr 1968. 11 p, 6 fig.

Descriptors: *Salinity, *Osmotic pressure, *Salt tolerance, Soil moisture, Soil-water-plant relationships, Absorption, Plant growth, *Transpiration, Arid lands, *Irrigation water, Wilting point, Deserts, On-site investigations, Leaves, Moisture availability, Groundwater.
Identifiers: Olive trees, Sap, Egypt.

An investigation was conducted at Burg El Arab, Egypt, aimed at extending the areas of the desert planted with olive as much as possible with the limited amount of water available in the desert region and to make use of saline underground water. Therefore a study was conducted to find out the highest salinity of the underground water that could be tolerated by the young developing plants and how much salinity controls water uptake. Also the effects of water supply were studied to determine the lowest moisture level required for the growth of the young plants, and to avoid the use of excess water. Young olive plants failed to grow when irrigated with water having an osmotic pressure of 25 atm. or higher. The successful growth of young plants irrigated with water having an osmotic pressure of 15 and 20 atm. indicated that young olive plants could be irrigated with underground water whatever its salinity provided that subsurface irrigation was applied to avoid capillary rise and accumulation of salts on the surface. (Affleck-Ariz)
W69-02397

3D. Conservation in Domestic and Municipal Use

METROPOLITAN WATER SUPPLY AND UTILIZATION.

Mass Ann Laws, Ch 92, Secs 16-19 (1966).

Descriptors: *Massachusetts, *Cities, *Water utilization, *Water supply, Legislation, Domestic water, Water districts, Water rates, Adjudication procedure, Environmental sanitation, Diversion, Administrative agencies, Regulation, Judicial decisions, Compensation, Fishing, Fouling, Wastewater (Pollution), Public utilities.
Identifiers: Abandoned waters.

Section 16 provides that no town, except Hingham and Hull, within ten miles of the state house, nor any water company in such town, shall, except in case of emergency, use for domestic purposes water from any source not now used by it except as provided in Chapter 92. Compensation for the taking of any water company in such town shall not be affected by Chapter 92. The section provides the procedure before the Supreme Judicial Court for setting water rates for Hingham and Hull. Section 17 empowers the Department of Public Health to make rules and regulations for the sanitary protection of such waters. The rules must be posted and published in a newspaper to give sufficient notice. The certificate of any member of the commission of such posting and publication shall be prima facie evidence thereof. Any of such waters abandoned as a water supply shall be open for fishing purposes. Section 18 is a general prohibition against diversion, pollution, and waste of the water supply of any town in the metropolitan water district. Section 19 specifies the classes of persons to which Section 18 is not applicable. (Smodish-Fla)
W69-02031

NATIONAL PLAN TO SUPPLY DRINKING WATER TO URBAN DISTRICTS, 1966-1970. (SPANISH).

Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 214-232, 1968. 19 p, 5 tab, 12 photo, 1 fig, 1 chart, append.

Descriptors: *Potable water, *Water distribution (Applied), *Urban sociology, Water resources development, Capital costs, Priorities, Water policy, Project purposes, Urbanization.
Identifiers: *Mexico, *National water-supply plan, Water management plan, Urban planning.

A National Plan to Supply Drinking Water to urban districts in Mexico is described as it was presented before the 7th National Congress of Civil Engineers, Guadalajara, in November 1967. The plan is an integral part of the national investment policy and calls for specific action on the part of private enterprise in cooperation with the Federal Government. Ultimate objective is auto-sufficiency for the water systems, both economically and administratively. The goal set is to enlarge and improve existing systems and initiate required new works. Priority will be given to cities that offer greater expansion possibilities, such as State capitals, seaports, tourist towns, and industrial centers. The intention is to benefit the 1,500 urban districts that are widely distributed and would serve 70% of the urban people by 1970. Only 48% had adequate water facilities in 1966. The plan calls for an investment totaling 2,000 million pesos. Administrative and legal aspects of the plan are carefully analyzed. (Lang-USGS)
W69-02366

3F. Conservation in Agriculture

SOUTH SASKATCHEWAN RIVER PROJECT,
I. B. Mackintosh.
Water Power, Vol 15, No 9, pp 361-8, Sept 1963, pp 403-8, Oct 1963.

Descriptors: *Tunnel construction.
Identifiers: *Mole tunneling, Canada.

Project between Government of Canada and Province of Saskatchewan is featured that is aimed to irrigate 500,000 acres in area affected by droughts, develop hydroelectric power, provide urban water supply, give flood control and provide recreational facilities; earthmoving operations on 8000 ft long 64 million cu yd dam are described in conjunction with embankment construction and construction of power intake shafts; use of 'Mole' tunnel boring machine for tunneling through shale.
W69-02076

IRRIGATION IN KANSAS.
Kansas Water Resources Board, Topeka.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-02348

HUMIDITY SENSOR: PERMANENT ELECTRIC HYGROMETER FOR CONTINUOUS MEASUREMENT OF THE RELATIVE HUMIDITY OF THE AIR,
Michigan State Univ., East Lansing.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02374

STRUCTURAL ALTERATION OF SOIL SURFACES BY TILLAGE AND RAINFALL,
Agricultural Research Service, Morris, Minnesota.
R. E. Burwell, R. R. Allmaras, and L. L. Sloneker.

J Soil and Water Cons, Vol 21, No 2, pp 61-63, March-April 1966. 3 pp, 2 fig, 2 tab.

Descriptors: Soil management, *Soil surfaces, *Infiltration, *Runoff, Water conservation, Erosion control, *Porosity, *Rainfall, Cultivation, Slopes, Soil structure, Loam, Pores, Rainfall-runoff relationships, Soil texture, Soil moisture, Moisture content.
Identifiers: Roughness.

The article discussed interrelation of rainfall with various tillage methods and advantages of each combination as a means of conserving water and combating erosion. Tillage methods used in the study were: untilled, plow, plow-disk-harrow, cultivated and rotovated. Rainfall was artificially applied to loam soil at the rate of 5 inches per hour to each of the freshly tilled surfaces. Rainfall decreased random roughness and total pore space of freshly tilled soil. Most of the decrease occurred during the period before initial runoff. Pore space modified the effectiveness of random roughness for delaying initial runoff. A large pore space alone did not delay initial runoff. A large initial runoff was modified by tillage practices. Cumulative infiltrations were significantly affected by all tillage treatments, but only in the case of rough surfaces was infiltration prior to initial runoff significantly greater than the cumulative infiltration which occurred following initial runoff. (Blecker-Ariz)
W69-02377

AN APPARATUS FOR MEASURING WATER POTENTIALS IN THE XYLEM OF INTACT PLANTS,
CSIRO, Griffith, N S W, Australia, Irrig. Res. Lab.
A. R. G. Lang, and H. D. Barrs.
Australian J Biol Sci, Vol 18, No 3, pp 487-497, June 1965. 1 pp, 5 fig, 4 tab.

Descriptors: Plant physiology, Hygrometry, *Xylem, *Temperature, Water vapor, *Vapor pressure, Moisture uptake, Instrumentation, Leaves, *Measurement, Energy budget, Calibrations, Equilibrium.
Identifiers: Thermocouple psychrometer, *Water potential, *Intact plants, Stem.

This paper described a new method and apparatus for estimating water potentials in the xylem of a plant. The method is based on the fact that energy of water in the vapor phase in equilibrium with the attached leaf gives a measure of the energy of water in the conducting elements of the stem xylem. Constant temperature of the leaf-vapor system was a critical requirement for the technique. The apparatus was based on the thermocouple psychrometer. Illustrative experiments were described in which continuous records of the estimated water potential in the xylem of cotton and pepper plants were given for periods of up to 10 hours. The method can, in principle, be applied to all plants in an arid climate which have suitable long petioles and broad leaves. (Blecker-Ariz)
W69-02378

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ARIDITY DEFINITIONS AND THEIR APPLICABILITY,
Swedish Meteorological and Hydrological Institute, Stockholm.
For primary bibliographic entry see Field 02B.
For abstract, see .
W69-02384

MANAGEMENT: A KEY TO IRRIGATION EFFICIENCY,
Water Conservation Laboratory, Phoenix, Arizona.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-02386

THE CLIMATE OF THE COTTON CROP: PHYSICAL CHARACTERISTICS AND MICROCLIMATE RELATIONSHIPS,
Volcani Institutue of Agricultural Research, Rehovoth, Israel.
G. Stanhill, and M. Fuchs.
Agricultural Meteorology, Vol 5, No 3, pp 183-202. May 1968. 20 p, 9 fig, 5 tab.

Descriptors: *Cotton, *Climatic data, *Irrigation effects, Humidity, *Microclimatology, Air temperature, Growth stages, Semiarid climates, Energy budget, *Crop response, Vapor pressure, Wind velocity, Albedo, Water loss, Hygrometry, Soil temperature, Anemometers, Solar radiation, Heat.
Identifiers: *Aerodynamics, *Energy balance, Israel, Solar elevation, Physical characteristics, Heat storage.

A study of the radiative and aerodynamic characteristics of two irrigated cotton crops was made in a semi-arid zone of Israel. Some of the physical characteristics of the irrigated cotton crop of importance in the modification of the crop microclimate were studied and the relationship between the climate over the crop and that measured at an adjacent open site were determined. Air temperature was always less and humidity greater at the irrigated crop than over the bare soil. Results obtained were compared with those previously reported in the literature for this crop in order to see to what extent they may be considered as being of general application. Microclimate is a factor of great importance in determining yield and water loss from agricultural crops. (Affleck-Ariz)
W69-02394

EFFECT OF IRRIGATION TREATMENTS ON ALFALFA (MEDICAGO SATIVA L.) PRODUCTION, PERSISTENCE, AND SOIL SALINITY IN SOUTHERN CALIFORNIA,
Imperial Valley Field Station, El Centro, Calif. and Calif. Univ, Riverside.
W. F. Lehman, S. J. Richards, and D. C. Erwin.
Hilgardia, Vol 39, No 9, pp 277-295. June 1968. 19 p, 8 fig, 6 tab.

Descriptors: *Alfalfa, *Irrigation effects, *Rates of application, California, *Crop response, Saline soils, *Salt tolerance, Soil-water-plant relationships, Tensiometers, Arid lands, Sampling, Leaching, Root zone, Diseases, Grasses, Winter, Percolation.
Identifiers: Imperial Valley (California).

In the Imperial Valley of Southern California two experiments were conducted to study effects of irrigation management on alfalfa yield, stand persistence, and soil salinity levels in the root zone. Irrigation treatments were based on frequency as determined by tensiometers and on duration of irrigation. In experiment I, where the soil was clay and clay loam, frequent short irrigation or moderate treatment was superior to normal short and frequent long irrigation treatments in yield, stand persistence, and hay quality. In experiment II where the soil was silty clay loam on top of sandy clay, yield was similar for all treatments, but an invasion of grass resulting from weaker stands reduced the quality of the hay produced in the frequent long treatment. Disease incidence was higher in the wet than the dry treatments. Soil salinity was inversely related to hours of applied irrigation in both experiments. (Affleck-Ariz)
W69-02395

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on THE Surface

KISTLER V WATSON (IMPROPER RESTRICTION OF STREAM FLOW).

156 A 2d 833-836 (Ct App Ohio 1959).

Descriptors: *Ohio, Civil law, Judicial decisions, Natural flow doctrine, Watercourses, *Dams, Riparian rights, Alteration of flow, Diversion, Reasonable use, Impounded waters, Farm ponds, Flow, Average flow, Natural flow, *Flow rates, Obstruction to flow.

A natural watercourse flowed across defendant's property and then across plaintiff's land. This spring ran for over fifty years until defendant constructed a dam to create a pool of water on his property. There was evidence that the stream was dry for the first time after the constuction of the dam. The court held that a riparian owner such as the defendant had a legal right to impound the water to create a pond provided he permited water to reach the land of the lower riparian owner in a substantially normal flow. Finding that the dam had materially affected the continuity of the flow and diminished the amount of water which unimpeded would otherwise have flowed onto plaintiff's land, the court ordered the defendant to restore the flow of water from the spring as it flowed in its natural course without artificial piping or diversion. (Scott-Fla)
W69-02001

MONTELIOUS V ELSEA (WITHDRAWAL FOR IRRIGATION).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02003

BURCH V MACKIE (SURFACE RUNOFF).
362 Mich 488, 107 NW 2d 791 (1961).

Descriptors: Surface water, *Alteration of flow, *Michigan, Legislation, Highways, Drainage, Highway effects, *Road construction, *Surface runoff, Drainage water, Surface drainage, Natural flow, Floods, State governments, Administrative agencies, Ditches, Diversion, Judicial decisions.

In the process of a highway improvement the state highway department caused changes in the drainage arrangement previously existing, which resulted in an unreasonable diversion of surface water damaging plaintiff's land. The road construction work also raised the crown of the highway causing a barrier to the natural flow of surface water. The attorney general of the State, appearing on behalf of defendant, filed a motion to dismiss claiming the highway department was engaged in a governmental function and thus immune from suit and liability, and that plaintiffs' proper remedy is afforded by the statutes relating to the establishment of drains by the county drain commissioner. The trial court dismissed the complaint on the basis that the condition complained of by the plaintiffs, may be remedied by proper proceedings under the Frain Code of 1956. The court here affirmed, but there is a separate concurring opinion based on the concept of governmental immunity, and an extensive dissent. (Smith-Fla)
W69-02018

CERNAK V KAY-VEE REALTY (LIABILITY FOR SURFACE DRAINAGE DISCHARGE).
169 N E 2d 879 (Mass 1960).

Descriptors: *Massachusetts, Watercourses, Negligent inundation, Damages, Value, Civil law, Judicial decisions, Outlets, Alteration of flow, *Drainage system, Controlled drainage, Drainage water, Surface runoff, Discharge, *Surface drainage.

Defendant, a land developer, constructed a surface drainage discharge system on its property that collected water from streets in a development project, and channeled it to a discharge pipe. After leaving this discharge pipe, the water passed through a culvert on land owned by a railroad, and then onto plaintiff's land making it very wet and swampy in spots. A landowner is permitted to improve his land by changes of grade, even if the natural course of the surface water is thereby changed, but he will be held liable for damages caused by discharge of water on the land of another by means of an artificial channel, either directly or by seepage. The fact that there was an intervening landowner between the plaintiff's tract and the defendant's tract cannot alter the defendant's responsibility, nor can the fact that other sources may contribute to the flow. (Scott-Fla)
W69-02020

SULLIVAN V BOARD OF COMMISSIONERS OF LORAIN COUNTY (INCREASED SURFACE DRAINAGE FROM UPPER LAND).
172 NE 2d 20 (Ohio Ct App 1960).

Descriptors: Judicial decisions, *Ohio, *Surface runoff, *Ditches, Reasonable use, Rainwater, Sewage effluents, Administrative agencies.

Defendant proposed to enlarge and improve a drainage ditch running from his upper land through plaintiff's lower land, to carry increased surface runoff due to improvement of the upper property and to accomodate sewage effluent from a proposed sewage treatment plant. Plaintiff filed suit to enjoin defendant from undertaking to widen and deepen such ditch. The court held that the ditch was a natural watercourse and if the defendant increased the flow by improving his land, there would be no liability unless he commits unreasonable or negligent acts. One who produces sewage must care for it and not permit it to injure his neighbor. However, since the plant was not yet constructed and placing effluent in the ditch, the court refused to act and said that if future injury did occur, that would be the proper time for judicial intervention. (Williams-Fla)
W69-02021

LOUISVILLE AND NASHVILLE R R V BUS (DRAINAGE OF SURFACE WATER).
336 SW 2d 578-581 (Ct App Ky 1960).

Descriptors: *Kentucky, Judicial decisions, Surface water, Runoff, *Surface runoff, Overland flow, Drainage, *Flood damage.

Appellant railroad company appealed a trial court decision which held it liable for flood damage resulting from drainage of surface water from its higher land onto appellee's lower land. Appellant installed a new drain pipe through railroad fill on the lower side of its property to replace an old damaged culvert. This allowed drainage of surface water from the upper land onto appellee's land. The court held that for appellant to be liable for damage to appellee's land from this flow it had to be shown that appellants had done something to increase the surface water flow, either additional drainage from another watershed or by diverting water from natural drains which otherwise would not have flowed through the pipe onto the low estate. Appellee failed to prove that appellant had done anything to alter the natural surface water drainage. The court reversed. (Sisserson-Fla)
W69-02023

LIABILITY FOR OVERFLOW OR ESCAPE OF WATER FROM EXCAVATION MADE IN COURSE OF CONSTRUCTION.
23 A L R 2d 827-830, 4 p, 11 ref.

Descriptors: *Overflow, *Flood damage, Dams, Reservoirs, Percolation, Percolating water, Subsurface runoff, Subsurface waters, Surface runoff, Floods, Repulsion (Legal aspects), Water law, Legal aspects.

The annotation considers the liability of an owner when water escapes from his land to that of an adjoining owner. The article distinguishes between the deliberate impounding of waters; the obstruction of streams; and the impounding of waters in the course of construction operations. The rule of absolute liability is variously applied to each of these situations. The article discusses the rule of absolute liability as it applies to the latter situation only. (Horner-Fla)
W69-02030

APPLICATION OF HUIE (LIABILITY FOR DIVERSION).
192 NYS 2d 620 (Sup Ct 1959).

Descriptors: Civil law, *New York, *Easements, *Eminent domain, Judicial decisions, Riparian land, *Diversion, Value, Alteration of flow, Riparian rights, Damages, Worth, Property values, Monetary worth, Relocation, Withdrawal municipal water.

In this proceeding by the Board of Water Supply of City of New York, the court held that persons who were nonriparian owners of land but owned easements permitting them and their guests access to the river were not trespassers in the use of river waters, since by implication, easements include the right to use the water. When the City of New York acquired rights to divert a river for the purpose of acquiring an additional water supply, nonriparian property owners having such easements were awarded damages to compensate them for the decrease in value of their lands caused by the diversion. The measure of damages was the difference between the value of their properties immediately prior to and after the diversion of the river. (Scott-Fla)
W69-02034

REPAIRS AND CLEANING OF CANALS SEWERS OR AQUEDUCTS; WORKS OBSTRUCTING OR EMBARRASSING PUBLIC PLACES, NAVIGABLE RIVER BEDS OR BANKS.
La Civil Code art 860, 861.

Descriptors: *Louisiana, Civil law, Ownership of beds, Banks, *Public rights, Riparian land, State governments, *Cleaning, *Repairing, Maintenance, Canals, Sewers, Aqueducts, Public benefits, Public health, Safety, Beds, Streambeds, River beds.

The cleaning or repairing of canals, spouts, sewers, or aqueducts by owners may not be objected to, because such work benefits the public interest and safety. Works formerly built on public places, or in the beds or on the banks of rivers or navigable streams, that interfere with the use of same, may be destroyed at the expense of those claiming ownership, at the instance of any legally competent resident. (Scott-Fla)
W69-02037

JURISDICTION OF COURT WHERE BODY OF WATER IS PARISH BOUNDARY.
La Crm Pro Code Ann art 613 (West 1967).

Descriptors: *Louisiana, Legislation, *Jurisdiction, Legal aspects, *Local governments, *Boundaries, Bodies of water.
Identifiers: Courts.

When a body of water is a parish boundary, the jurisdiction of the court of such parish extends to the middle of such body of water. (Childs-Fla)
W69-02038

DUTIES OF CITY ENGINEERS -- POWERS OF POLICE JURIES.

La. RS 1965 33:727 and 1236-1237.

Descriptors: *Louisiana, Civil law, Drainage districts, *Local governments, State governments, Engineering personnel, Drains, Ditches, Canals, Culverts, Streams, Sewers, Water courses (Legal), Dikes, Dams, Levees, Banks, *Navigation, Inland waterways, Transportation, Public health, Seepage, Legislation.

Subject to the supervision and control of the city manager, the city engineer shall manage and have charge of, among other things, the construction, improvement, repair and maintenance of sewers, drains, ditches, culverts, canals, streams, and watercourses. Police juries shall have the power to regulate, among other things, the making and repairing of dikes, dams, and levees; and to regulate the clearing of the banks of rivers and natural drains for the purpose of improving navigation. Police juries may also build dams to prevent the passage or encroachment of salt water into fresh water streams, when such salt water is found to be injurious to property; and may create drainage districts, to control all drainage, drainage ditches, and drainage canals. Police juries may also institute eminent domain proceedings, or purchase or lease lands needed for the construction and improvement of the Inland Water Channel; and may close and dam on its own initiative certain small canals or streams which it finds hazardous or harmful to property or to the public health. (Scott-Fla)
W69-02040

LEVEES AND DRAINAGE IN GENERAL.
La RS 38:111-225 (1965).

Descriptors: *Louisiana, Drainage districts, *Drainage, Local governments, Right-of-way, State governments, Utilities, Construction, Maintenance, *Levees, Overflow, Mississippi River, Bayous, Navigation, Public rights, Eminent domain, Canals, Roads.
Identifiers: Crimes, Criminal offenses.

Any drainage district may contract with the department of public works for drainage and reclamation projects. Local levee authorities shall cooperate with the state and federal governments for construction and maintenance of all levees necessary for protection against overflow of the Mississippi River. The various districts shall control all public drainage channels within the limits of their districts, and for one hundred feet on each side of the channel. When levees cross bayous or sloughs, certain construction methods must be used. Works erected in front of levees shall be destroyed at their owner's expense when they interfere with navigation or the use of the public. Police juries shall have the power to expropriate land or improvements for drainage canals or projects. All levees and parallel or contiguous public roads must be drained. Police juries may also erect back and side levees when needed, as well as temporary levees. Cities and towns have the same general powers as police juries concerning levees. It is a criminal offense to willfully cut or destroy any levee, or to attempt to do so. It is also an offense to ride, drive, or haul upon public levees except where provision is made for same by the levee commissioners; to obstruct drainage by dumping materials into any waters or drains; to drain oil, salt water, or noxious substances into any natural drain or stream; to drain water onto a public road; or to otherwise interfere with or obstruct drainage of any road or channel. (Scott-Fla)
W69-02041

REGULATION OF CANALS.

La RS 1965 45:61-67.

Descriptors: *Louisiana, Hydroelectric project licensing, *Right-of-way, *Canals, Irrigation, Irrigation canals, Navigable waters, Irrigation permits, Public utilities, Hydroelectric power, Hydroelectric plants, Transportation, Transmission lines, Reservoirs, Dikes, Damsites.

Domestic corporations formed for the purpose of constructing and operating canals for irrigation by gravity have the power to obtain rights-of-way by purchase or expropriation, and to use the waters of the state, including navigable streams, for irrigation purposes. Such corporations have the status of public service corporations. Domestic corporations not included above that are organized for the development of hydro-electric power or the transportation of freight or passengers have the power to obtain rights-of-way for these canals and for telephone, telegraph, and hydro-electric lines, as well as lands for reservoirs, damsites, and dikes, by similar methods. Maximum widths for rights-of-way are prescribed. (Scott-Fla)
W69-02042

SAINATO V POTTER (DAMAGES FOR DRAINAGE OF SILT ONTO ADJOINING PROPERTY).
222 Md 263, 159 A 2d 632-636 (Ct App 1960).

Descriptors: *Maryland, *Reasonable use, *Damages, *Deposition (Sediments), Judicial decisions, Water law, Surface waters, Natural flow, Natural flow doctrine, Civil law, Real property, Property values, Depreciation, Obstruction to flow, Surface drainage, Silts, Mudflows, Elevation, Landfills, Grading.
Identifiers: *Remedies, Damages (Legal aspects).

Plaintiffs sued for damages caused by surface water, silt, and debris draining from defendants' property onto plaintiffs' adjoining land. The trial court awarded plaintiffs $1000 damages. Defendants, whose land was higher in elevation, placed fill on their lot and had a bulldozer level it off, thereby pushing the new earth very near the boundary with plaintiffs' land. Mud, silt, and debris were washed by rainfall onto plaintiffs land, killing several trees and destroying plaintiffs' vegetables. When strict application of the civil law rule results in hardship on either the higher or lower landowner, Maryland courts apply the 'reasonableness of use' rule. The appellate court held the plaintiffs were not entitled to recover for the surface water flowing onto their land after the elevation of defendants' property, but they were entitled to recover for defendants' failure to take reasonable precautions to prevent damage from the excess dirt, silt, and debris. After stating the Maryland rule for the measure of damages for injuries to real property, the court upheld the decision holding defendants liable, but reversed and remanded the case for additional testimony on the amount of damages. (Smodish-Fla)
W69-02045

HALL V TOMER (DAMAGES FOR DIVERTING SURFACE WATER).

42 West 41-48 (Pa Com Pl 1959).

Descriptors: Ditches, Drainage, Runoff, Storm runoff, *Surface runoff, Surface drainage, *Natural flow doctrine, *Pennsylvania, Precipitation excess, Pipes, Riddance (Legal aspects), Water law, Damages, Judicial decisions.

Defendants' land lay at a higher elevation than that of plaintiff, and was being developed into a housing division with streets running in the direction of plaintiff's land which diverted water onto plaintiff's land. It was found that plaintiff's land lay in the natural water course for water flowing from defendants' land prior to its development. The owner of

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upper land has the right to have surface water flowing over his land discharged through a natural water course onto the land of another. Plaintiff requested that defendants install and maintain drainage ditches and pipes over to other drainage facilities at another highway; that defendants remove all debris from plaintiff's land; and that he be awarded $1,860.75 in damages. The court ordered defendants to install drainage facilities sufficient to alleviate the problem caused by defendants' streets diverting surface water, but left it to the defendants to determine how this was to be done. Defendants were not required to remove the debris from plaintiff's land as the precipitation that caused it was extremely heavy resulting in defendants' excavations not being entirely responsible for this mud and silt. This problem of causation also resulted in a damage award of $317.00 instead of that requested by plaintiff. (McDermott-Fla)
W69-02046

WARD V CITY OF GEORGETOWN (LIABILITY FOR FLOODING).
28 111 App 2d 447, 171 N E 2d 653 (1961).

Descriptors: *Illinois, Watercourses, Flooding, *Flood damage, Negligent inundation, Damages, Value, Civil law, Judicial decisions, Dams, Crops, *Eminent domain, Cities.

Action by landowners against city for damage to crops and permanent damage to land caused by flooding which was a result of the city's raising of its dam. The court awarded damages to the landowners, because pursuant to the state constitution, private property should not be damaged for public use without just compensation. The evidence showed that the city's dam was a public use and the damage to the plaintiffs' lands was a direct and immediate result of the construction and subsequent modification of the dam. (Scott-Fla)
W69-02047

WACHSMUTH V STONE'S MARINA, INC. (RIPARIAN RIGHT OF ACCESS).
26 Misc 2d 466, 214 NYS 2d 15-18 (1960).

Descriptors: *New York, Judicial decisions, *Riparian rights, Barriers, *Access routes, Right-of-way, Navigable waters, Boats, Bays.
Identifiers: Limited interference.

Plaintiff sued for a mandatory injunction to require removal of an obstruction, a road crossing, from a waterway. Plaintiff claims that the obstruction, although on defendant's property, deprives plaintiff of his riparian right to gain access to the bay by boat through this waterway. The suit was properly raised under New York statute. The court found that plaintiff rarely used the waterway in question and he had access to the bay from another portion of his land. The construction of the road was not substantial enough to seriously interfere with the use and enjoyment of plaintiff's premises. (Sisserson-Fla)
W69-02049

JOHNSON V WILLIAMS (SURFACE DRAINAGE).

121 S E 2d 223-232 (S C 1961).

Descriptors: *Surface drainage, *Watercourses (Legal), Natural flow, Flooding, Flood damage, Surface runoff, *South Carolina, Repulsion (Legal aspects), Riddance (Legal aspects), Water law, Drainage systems, Water control, *Obstruction to flow, Ditches, Drainage, Pipes.

The respondent and the appellant owned adjoining lands. Water from the lands of respondent and other upper landowners drained across the farm of appellant. The appellant obstructed the flow of this drainage and the respondent brought this action to recover for damages alleged sustained by flooding and for an injunction. The basic issue in the case was whether or not the drainway was a natural watercourse. The respondent contended that it was while the appellant contended that it was not that only surface waters were involved. The obstruction of the flow of surface water is generally not actionable, while the obstruction of the flow of a natural watercourse, if it results in damage to an adjoining landowner, is actionable. This court affirmed stating that there was ample evidence upon which to base the findings of the jury that appellant obstructed a natural watercourse. (Smith-Fla)
W69-02051

EVANS V WHEELER (LIABILITY FOR STREAM RELOCATION).
348 S W 2d 500 (Tenn 1961).

Descriptors: Eminent domain, *Tennessee, Diversion, Alteration of flow, *Relocation, *Damages, Value, Market value, Property values, Worth, Appreciation, Civil law, Judicial decisions, Right-of-way, Land appraisal, Watercourses.

Davidson County diverted a stream and rechanneled it so as to completely remove it from plaintiff's land. Eminent domain proceedings were not instituted because of the County's mistaken belief that the stream was entirely within its right of way. The court said that the measure of damages to which plaintiff is entitled is the decrease in the market value of the riparian land by reason of the diversion of the water. No damages were awarded because by diverting the stream the County had increased, rather than decreased, the value of the plaintiff's land. Prior to the diversion plaintiff's land was subject to periodic flooding, while after the diversion it was suitable for development in the same manner as more valuable adjoining tracts of land. No adjustment was made for appreciation of market value.
W69-02052

FORMAN V FLORIDA LAND HOLDING CORPORATION (ACCRETION - LEGAL ASPECTS).
State of Florida, Tallahassee.

121 So 2d 284-788 (Fla 1960).

Descriptors: *Florida, *Boundaries (Property), Judicial decision, *Riparian rights, *Accretion (Legal aspects), Erosion, Swamps, Coastal marshes, Legislation, Maps, Oceans, Tidal effects, Atlantic Ocean, Shores, Land, Riparian land, Legal aspects.

Appellants contend that Government Lot 2 claimed by the appellees was swamp and overflow land which was acquired by the State of Florida under the Swamp Land Act of 1850, and as such does not support riparian rights as an appurtenance. Therefore, appellants assert that the 1870 west boundary line of New River Sound constituted an established fixed east line of Government Lot 2, and that the owner of this lot enjoyed no riparian rights resulting from any accretion to its eastern boundary. Riparian rights may be appurtenant to swamp and overflow lands conveyed to the state under the Swamp Land Act. In affirming the decision this court found that the evidence sustained the finding that Government lot 1 had submerged as a result of erosion caused by the severity of the elements and that there was no basis for appellants contention that it became an 'immigrant parcel' of land which had migrated intact directly west to a new location on the boundary of Government Lot 2. (Smith-Fla)
W69-02053

SEABOARD AIR LINE R CO V COUNTY OF CRISP. (FPC - LICENSING).
280 F 2d 873-878 (5th Cir 1960).

Descriptors: *Georgia, Judicial decisions, Legislation, Federal Power Act, *Hydroelectric project licensing, Hydroelectric plants, Rivers, Navigable rivers, Dams, Administrative agencies, *Water levels, Damages, Impoundments, Local governments, *Embankments, Railroads, Eminent domain, Erosion control.

Crisp County, Georgia was empowered by an amendment to the Georgia Constitution to build a dam across the Flint River and to erect and operate a hydroelectric plant. The river at the site where the dam and generating plant were built was navigable and the county was required to procure a license from the FPC. The building of the dam and the consequent raising of the water level damaged an embankment and trestle of the Seaboard Railroad. The county executed a contract with the railroad in 1939, agreeing to repair the damage done at that time and to protect the embankment in the future. The county repaired the damage in 1939, but refused to repair the current damage. The law in Georgia permits counties to be liable upon their contracts only when the state has authorized the incurring of the liability asserted. This court reversed the decision of the district court for the county on the basis of the broad general power of contract granted in the amendment authorizing the project. (Smith-Fla)
W69-02054

APPLICABILITY OF RULES OF ACCRETION AND RELICTION SO AS TO CONFER UPON OWNER OF ISLAND OR BAR IN NAVIGABLE STREAM TITLE TO ADDITIONS,
C. C. Marvel.
54 ALR 2d 643-655.

Descriptors: *Riparian rights, Riparian land, Judicial decisions, *Accretion (Legal aspects), Islands, Navigable rivers, *Boundaries (Property), *Ownership of beds, Erosion, State governments, Legal aspects, Water law, Mississippi River, Channels, Missouri River, Navigable waters, Legislation.

As a general rule, the owner of an island is entitled to any additions thereto, in the same manner as is the owner of riparian land on the mainland. Both types of owners are equally affected by the existence in a jurisdiction of either of the opposing theories of ownership of the bed of a navigable stream. Under the theory that the state owns the bed, the owner of the island is entitled to all accretions to the island even if the accretions meet other land, or in the absence of a statute to the contrary if the accretions occupy a part of the stream formerly occupied by the land of another which has eroded away. Under the theory that the riparian owner owns to the middle of the stream, the owner of the island is entitled to accretions to the center of the channel between the island and the mainland. (Smith-Fla)
W69-02055

LIABILITY, AS REGARDS SURFACE WATERS FOR RAISING SURFACE LEVEL OF LAND,
W. E. Shipley.
12 A L R 2d 1338-1352.

Descriptors: Land development, *Land forming Graded, *Surface drainage, Alteration of flow, Judicial decisions, Surface waters, Diversion, Obstruction to flow, Watercourses (Legal), Water law, *Civil law, Legal aspects, Elevation, Repulsion (Legal aspects), Reasonable use.

One of the ordinary consequences of the filling or grading of land is the diversion of surface water which normally flowed over the land. Because of such diversion, the surface water may flow onto or fail to leave the land of another. The legal problems arising when surface water is diverted by improvements resulting in a general elevation of the surface land are discussed and illustrated by a collection of judicial decisions. Problems created by the blocking of natural or artificial watercourses which drain surface waters are beyond the scope of this annotation. The various jurisdictions are widely divided as to the general rules which govern the rights, duties and liabilities arising from the flow of surface waters. Many jurisdictions have adopted the 'common enemy rule,' others have adopted the

ivil law rule. Both of these rules are discussed at ength including certain modifications such as the easonable user rule. (Smith-Fla)
V69-02057

AND CUT OFF BY RUNNING STREAM.
a Code Ann Sec 85-1608 (1967).

escriptors: *Georgia, Legislation, *Streams, Boundaries (Property), Boundary disputes, Alteration of flow, *Channel flow.

Where a watercourse formed one of the boundary nes of a tract of land, and its course was changed y nature or art so that the present channel cuts off part of said tract, the processioners and surveyor all certify the fact and the plat of the surveyor all plainly mark the present and original channels, designating the exact quantity of land so cut ff. (Williams-Fla)
V69-02059

UBLIC WORKS AUTHORIZATIONS, 1968 IVERS AND HARBORS - FLOOD CONTROL ND MULTIPLE PURPOSE PROJECTS - PART

earings before the Subcommittee on Flood Control - Rivers and Harbors of the Committee on ublic Works, U S Senate 90th Congress, 2nd Session, May 14, 15, 16, 21, 22 and 23, 1968.

escriptors: United States, Legislation, *Indiana, llinois, *Ohio, Flood control, Water supply, iver basins, Reservoir sites, *New York, Channel nprovement, Drainage systems, Dams, Project lanning.
dentifiers: Maintenance costs.

his report to the Subcommittee was on the Vabash River comprehensive study for Indiana, Illinois and Ohio. The main problems indicated were ood control, water quality and supply, and recreation in the Wabash basin. The recommended plan onsists of constructing the Louisville, Helm, Big Valnut and Big Blue Reservoirs, the Downeyville eservoir and the Marion project to meet these ater problems. The report on Port Jefferson Harbor, New York indicated inadequate channel epth. The recommended plan calls for enlarging he channel. The Licking River, Ohio, report indicated a flood problem and a need for water quali control and supply. The recommended plan calls or: (1) Utica dam; and (2) improvement of interir drainage and channel enlargement. This report n Buffalo Harbor, New York, revealed that drift in he waterways is hazardous to small boats, clogs ewers and menaces health. The recommended lan calls for maintenance costs to remove the rift. The report on Cleveland Harbor also reveals rift and the recommended plan calls for mainenance costs for removal. (Childs-Fla)
V69-02070

UBLIC WORKS AUTHORIZATIONS, 1968 IVERS AND HARBORS - FLOOD CONTROL ND MULTIPLE PURPOSE PROJECTS - PART

earings before the Subcommittee on Flood Control - Rivers and Harbors of the Committee on ublic Works, U S Senate 90th Congress, 2nd Session, May 14, 15,16, 21, 22 and 23, 1968.

escriptors: United States, *Florida, Legislation, Beach erosion, Hurricanes, Floods, Landfills, Harbors, *Navigation, Channel improvements, ocal governments, Earthdikes, Drainage systems, roject planning.
dentifiers: Florida Board of Conservation.

he Subcommittee considered additional Public Vorks Authorizations. The next reports were on everal Florida projects accompanied by statements from the Florida Board of Conservation. The ade County report indicated an erosion and hurricane problem causing beach loss and tidal flooding. The recommended plan calls for the construction of a protective beach and dune and periodic beach nourishment. The Brevard County report indicated erosion damage threatening upland improvement and reducing beach area. The recommended plan calls for artificial placement of beach fill. The Port Sutton, Tampa Harbor report indicated a navigational problem of insufficient channel depth precluding the use of larger vessels. The recommended plan provides for maintenance of the channel and basin as improved by local interests. The Hillsborough Bay report indicated a hurricane flood problem. The recommended plan calls for an earthfill levee and barrier and construction of a hydraulic model for the study of water utilization and control in the area. The Martin County report showed periodic flooding caused by inadequate drainage and control works. In drought periods irrigation is needed. The recommended plan calls for canals and control structures for gravity drainage. Irrigation features would be deferred. (Childs-Fla)
W69-02071

PUBLIC WORKS AUTHORIZATIONS, 1968 RIVERS AND HARBORS - FLOOD CONTROL AND MULTIPLE PURPOSE PROJECTS - PART 4.

Hearings before the Subcommittee on Flood Control - Rivers and Harbors of the Committee on Public Works, U S Senate 90th Congress, 2nd Session, May 14, 15, 16, 21, 22 and 23, 1968.

Descriptors: *United States, Legislation, *Massachusetts, Channel improvement, *New Hampshire, Flood protection, Water supply, *North Carolina, Water storage, Delaware, Beach erosion, South Carolina, Maryland, Project planning.
Identifiers: Public Works Authorizations, Corps of Engineers Reports.

The subcommittee considered reports by the Corps of Engineers and heard other testimony on Public Works Authorizations. The report on the Ipswich River, Massachusetts, revealed shoaling at the river mouth hindering recreational boating and commercial fishing. The recommended plan called for a channel, two anchorage areas, and a jetty to prevent entrance shoaling. The report on the Beaver Brook Dam and Reservoir, Keene, New Hampshire revealed a flood problem, a need for water based recreation and water supply. The report on the Cape Fear river basin, North Carolina, revealed flood damage and a need for water storage, water quality control and recreation. The recommended plan calls for a dam and reservoir at the Randleman and Howard Mill sites. The report on the Delaware coast revealed beach erosion. The recommended plan calls for beach widening, bulkhead, stone revetment and sand fence construction. The report on the Cooper River, South Carolina, revealed a navigational problem of serious silting and shoaling. The recommended plan is to redivert the Santee River and construction of a hydroelectric plant. The report on the Six Bridge Project in Maryland indicated a water supply and water quality improvement problem. This plan calls for a concrete gravity-earth structure to create a reservoir. (Childs-Fla)
W69-02072

SURFACE WATER IN INDIANA,
Thomas L. Shaffer.
Indiana L J, Vol 39, No 1, pp 69-108, 1963. 40 p, 2 tab, 231 ref.

Descriptors: *Indiana, Hydrologic cycle, *Surface waters, *Riparian rights, Topography, Erosion, Evaporation, Repulsion (Legal aspects), Civil law, Flow, Banks, Floodwater, Watercourses (Legal), Irrigation, Streams, Water pollution, *Judicial decisions, Water law.
Identifiers: Soil composition, Common law.

The hydrologic cycle is discussed, particularly with reference to Indiana. The effect of topography, soil composition, evaporation, and growing season on the cycle is covered. The civil and common law governing surface water is set forth. Indiana seems to follow the common law as to lower owners and a modified common law position as to upper owners. Generally, the surface water problem is one of disposal. The problem of defining surface water is examined and the factors for consideration in Indiana are: time of flow, banks, local name or not, direction, origin, usefulness, and distance. Indiana seems to view flood water as surface water if it leaves its watercourse once and for all. The author discusses at great length the rights and duties of upper and lower owners, which have evolved through Indiana case law. Conserving surface water helps restore ground water supplies, keeps lake levels high and assures reliable flows in streams. Also, erosion and flood damages caused by the surface water are mitigated. The idea that surface water is a nuisance is out of date. Any water in the state which can be made to contribute to public needs should be marshalled for this purpose and property owners who marshall it reasonably should be given judicial protection.
W69-02073

STORM SEWER TUNNEL 'THREADS NEEDLE' BETWEEN HIGHWAY BENTS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02077

SEWER DEPTH OF FLOW DETERMINATION,
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-02089

STORM SEWAGE SEPARATION BY HELICAL MOTION,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02090

MODEL INVESTIGATIONS OF DIFFERENT TYPES OF STORM-WATER OVERFLOWS AND THEIR EFFECT ON THE SEWAGE WORKS AND THE RECEIVING STREAM,
B. Erfmann.
Technische-Wissenschaftliche Mitt, No 3, 1960.

Descriptors: *Overflow, *Storm runoff, *Water pollution, *Weirs, Design, *Model studies.

Investigations with a model plant are described into the effect of the design and position of storm-water overflows on the distribution of polluting matter between the sewage works and the stream. Weir designs which ensure that the greatest possible amount of polluting matter passes to the sewage works are discussed.
W69-02091

THE PERFORMANCE OF STILLING PONDS IN HANDLING SOLIDS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02092

STORM FLOWS FROM COMBINED SEWERAGE SYSTEMS IN THREE AREAS,
A. L. H. Gameson, R. N. Davidson, and J. M. Threlfall.
Instn Publ. Hlth Engrs J, Vol 64, pp 182-208, 1965.

Descriptors: *Storm runoff, *Overflow, Discharge (Water).
Identifiers: *Combined sewers, *Calculations.

Results are given of investigations at Northampton, Brighouse, and Bradford on the frequency and duration of operation of storm-sewage overflows on

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combined sewerage systems and on the volume of storm sewage discharged, since this knowledge is required when determining the optimal setting for an overflow. From the results, equations have been developed which were found to fit not only the data from these three systems but also those from a partially-separate system at Luton; some examples are given of the use of the equations to determine the setting so that the overflow would operate only on a certain number of occasions per year or that the average yearly discharge should be a certain percentage of the rainfall.
W69-02093

USE OF STORM WATER OVERFLOWS ON SEWERS: THEIR DESIRABILITY, AND RISKS OF POLLUTION,
J. H. Garner.
Survr, Vol 108, p 131, 1949.

Descriptors: *Overflow, Sewers, *Water pollution, *Storm runoff.

Considerable pollution of surface waters is caused by sewage discharged from storm water overflows. Author considers that in many cases improvement could be effected by reducing the number or altering the position of overflows and in some instances larger volumes could be treated at the sewage works.
W69-02094

STORM-WATER CONTROL BY SIPHON SPILLWAYS AT EARLSWOOD SEWAGE WORKS, REIGATE,
J. M. Harwood.
J Inst Sew Purif, Pt 2, 1960.

Descriptors: *Siphons, *Spillways, *Storm runoff, *Weirs.

At the Earlswood sewage works of Reigate, Surrey, storm water was formerly separated by means of a normal side weir following the line of the main inlet channel, but this was not satisfactory. It was therefore decided to install a series of siphon spillways. The reasons for this decision are listed, and details of the installation are described.
W69-02095

TESTING AND CALIBRATION OF STORM OVERFLOW CONTROL PIPES,
K. Hutton.
Contract Rec, Vol 70, No 23, p 13, 1959.

Descriptors: *Stilling basins, *Overflow, *Flow control, *Storm runoff, Discharge (Water), Velocity, *Instrumentation.
Identifiers: *Suspended solids.

The stilling pond overflow pipe, which provides the most efficient means for the separation of 6 times the dry weather flow from storm water flows, and for removing suspended solids from storm water, is described, and the one in use at Mixenden is presented diagrammatically. Tests carried out at Halifax on this type of overflow and its calibration are given in detail, and show the variation between discharges allowed for in design and those met with in practice. Equations are derived for the determination of several factors including the hydraulic gradient, velocity head, and friction loss. From the studies so far carried out, it was concluded that the stilling pond is the best type of storm overflow at present in general use.
W69-02096

TESTS ON A MODEL STILLING POND WITH SIPHON OVERFLOW,
P. M. Jarrett, H. F. Griffiths, and E. Markland.
Civ Eng Publ Works Rev, Vol 59, 346, 1964.

Descriptors: *Stilling basins, *Model studies, *Siphons, *Overflow, *Water pollution control, *Storm runoff, Weirs, Instrumentation.
Identifiers: *Suspended solids.

The use of stilling ponds is considered to be the most effective way of reducing pollution from storm-water overflows, since an efficient stilling pond should retain much of the solid matter discharged during the first flush of storm water and subsequently pass it down the sewer as the level falls. The authors have carried out preliminary tests on a model stilling pond equipped with a siphon in place of the usual overflow weir; the results, which are discussed briefly, warrant more detailed investigations, using suspended particles of various sizes over a continuously graded spectrum of specific gravity, to establish optimal proportions for stilling ponds with siphon overflows.
W69-02097

CRITICAL OBSERVATIONS ON THE HYDRAULIC DIMENSIONING OF STATIONARY RAIN OVERFLOWS,
J. Jehne.
Wasserwirtsch-Wassertech, Vol 17, No 4, pp 121-127, April 1968.

Descriptors: *Overflow, *Hydraulics, *Storm runoff, Dilution, Sewage sludge.

After presenting the weak points of the notion 'dilution' in hydraulic measurement of stationary rain overflows, the author recommends the specific content (related to the unit of water amount) of one or more components (specific load) as the criteria for the admissible load of the receiving stream. The developed formulas permit: the calculation of the expected upper limit value of the specific load and the calculation of the overflows; the numerical expression of the conditions in case of more overflows from the same collector; and exact information about the effects of sludge whirl-up in the collector or about the imperfect mixing of the individual incoming and outcoming amounts. The influence on the load can be expressed by the (temporary or continuous) magnitude change in one of the load determining factors.
W69-02098

A CONTRIBUTION TO HYDRAULIC CALCULATIONS ON LATERALLY-BAFFLED STORM-SEWAGE OVERFLOWS,
G. J. Kallwass.
Thesis, Technische Hochschule, Hannover, 1964, 165 pp.

Descriptors: Design, *Hydraulic design, *Overflow, *Storm runoff, Weirs, Discharge (Water).
Identifiers: *Calculations.

In connexion with the design of storm-sewage overflows, pilot-plant experiments were carried out at the Institut fur Hydromechanik, Hannover, to calculate the conditions of flow before and after passage over a weir at varying angles, taking into consideration geometrical characteristics when calculating the discharge after a peak load. The equation used for the calculation is based on those for overflowing weirs.
W69-02099

THROTTLE MEASURING DEVICE OF RAIN-WATER OVERFLOWS,
G. J. Kallwass.
Gas-Wasserfach, Vol 109, No 6, pp 150-155, 1968.

Descriptors: *Storm runoff, *Overflow, Outlets, *Weirs, Flow measurement, *Instrumentation, *Model studies.

Rainwater overflows with high weirs and throttled outlet systems have recently been used to limit the load of receiving streams. The infeed system lying above the weir limits the duration and frequency of the overflow. The efficiency of the throttle line is determined by the diameter, the length, and the slope of the bottom of the line. Because of high costs it is not advisable to undertake any reconstruction of the throttling line or to construct it behind already existing non-throttled rainwater overflows. The same holds true for repairs of errors caused by incorrect calculations. In such cases, use is made of the throttle stop. Located above the canal network outlet, the stop closes the flow in the upper infeed section of the network. A method is described to calculate one-sided rainwater overflows with throttle stops. This method can be applied in almost all cases in which, in the infeed portion, a normal streaming run-off (t sub N > t sub gr) is observed or in which, in the case of a shooting normal run-off (t sub N < t sub gr), a streaming run-off above the weir can be forced (S sub N < sub o). The parameters required for the calculations were obtained on models with circular pipes. However, they can be applied for other cross sections as well, provided the same conditions are observed.
W69-02100

THE STORAGE AND DISCHARGE CAPACITIES OF SEWERAGE AND THE OPERATING FREQUENCY OF STORM OVERFLOWS DUTCH METHOD OF CALCULATION,
A. C. J. Koot.
Symposium on Storm Sewage Overflows, May 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Discharge (Water), *Storm runoff, *Overflow, Pumping.
Identifiers: *Capacity, Surface permeability, *Calculations.

This system is based on the principle that a system must be filled before diluted sewage is discharged into the surface water. It assumes that part of the precipitation received in the impervious area: (a) flows into the sewerage system; (b) is discharged or pumped off near the end of the main sewer; and (c) may be discharged into the surface water via storm overflows. Calculations are restricted to those for the static storage capacity. The figure calculated is the capacity of the sewer pipes between the top of the lowest overflow (s) and the highest water level in the sump of the pumping station, or level of discharge. The available discharge capacity is considered, with schematic representations for both flat and sloping areas shown. A scatter diagram of the amount of rain in mm's plotted against the duration of the rain in minutes for 195 showers of more than 7 mm. which fell in DeBilt, Utrecht between 1938 and 1948 is also included. On the basis of the given assumptions, it is possible to determine the approximate number of showers giving rise to overflow of sewage for the 11 year period.
W69-02101

THE DESIGN AND EFFICIENCY OF STORM WATER OVERFLOWS IN COMBINED SEWERAGE SYSTEMS,
H. Lohff.
Gesundheits-Ing, Vol 75, pp 397-9, 1954.

Descriptors: *Overflow, *Storm runoff, *Water pollution, Discharge (Water), Design, *Sewage sludge.
Identifiers: *Combined sewers.

The author discusses the problem of pollution of streams by storm water overflows and methods of reducing both the amount of storm water that is discharged and the polluting matter carried. Alterations in the design of the overflow are suggested with special attention to increasing the height of the overflow sill to form a storage chamber where sludge washed from the sewer could collect.
W69-02102

LOSS OF SANITARY SEWAGE THROUGH STORM WATER OVERFLOWS,
J. E. McKee.
Sewage Works J, Vol 20, pp 589-90, 1948.

Descriptors: *Storm runoff, *Overflow, *Rainfall intensity.

Identifiers: *Boston (Mass), *Interceptor sewers, *Combined sewers, Capacity.

Data are given on the rainfall at Boston, Mass.; the effect of rainfall on the flow of intercepting sewers of the combined sewerage system; the proportion of sewage in storm water overflows, and the frequency of overflow. It was found that storm water runoff equal in volume to the dry weather flow of domestic sewage was produced when rainfall was 0.01 in/hr. When twice the average dry weather flow was intercepted about 2.7% of the total amount of domestic sewage overflowed. Overflow occurred about 5-6 times/month in the summer. The effects of increasing the capacity of the interceptors on the amount of sewage in the overflow and on the frequency of overflow is discussed.
W69-02103

LOSS OF SANITARY SEWAGE THROUGH STORM WATER OVERFLOWS,
J. E. McKee.
J Boston Soc Civ Eng, Vol 34, No 2, pp 55-80, April 1947.

Descriptors: *Storm runoff, *Overflow, *Rainfall intensity.
Identifiers: *Boston (Mass), *Interceptor sewers, *Combined sewers, Capacity.

In comtemplating design of intercepting sewers, relation between storm run-off and sewage; and similar problems were studied at Boston, Mass; data on rainfall and rainfall probability; run-off from low intensity rainfall; relation between run-off and dry weather sanitary flow; duration and extent of sewage overflows; effect of interceptor capacity on frequency of overflow of sanitary sewage.
W69-02104

ONE WAY TO BYPASS A LARGE SEWER,
For primary bibliographic entry see Field 08C.
For abstract, see .
W69-02105

RECONSTRUCTION OF OVERFLOWS,
W. H. G. Mercer.
In Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Storm runoff, *Overflow, Storms, Design.
Identifiers: *Calculations, *Suspended solids.

The policy adopted by the city of Rochdale to accept all liquid trade wastes made it necessary to recalculate the loads on the entire system. This recalculation led to the decision to reconstruct some of the original storm sewage overflows to accept the additional loads. Since a large number were involved it was decided to reconstruct one overflow on an experimental basis first. Part of the experiment was to determine the conditions when a storm occurred which only just put the overflow into operation. The effect of surcharging the sewer before allowing the overflow to begin was that nearly all floating matter was held back some distance upstream. Matters of public relations undertaken when an overflow in a shopping area was reconstructed are given in detail. Although the work on overflows has formed part of a comprehensive program, the reconstruction of each had its particular problems. Ultimate design was dependent on a number of existing factors, some fixed and some varying with limits. As work progressed, it was observed that: (a) a far greater volume of sewage was being passed to the sewage works; and (b) the discharge of floating matter to the water courses during storms was decreasing.
W69-02106

PRACTICAL DESIGN OF STORM SEWAGE OVERFLOWS,
P. R. Oakley.
In Symposium on Storm Sewage Overflows, May 4, 1967, sponsored by the Institution of Civil Engineers.

Descriptors: *Design, *Overflow, *Storm runoff, Hydraulics, Stilling basins, Equipment, *Weirs.
Identifiers: *Suspended solids.

The extent that the ideals of theory can be realized in the practical design of storm sewage overflows is discussed with special emphasis on efficiency and reliability. Two tests of efficiency for storm water overflows are: (a) hydraulic performance, and (b) separation of suspended solids. Hydraulic efficiency implies that overflow does not commence prematurely and that the base flow does not vary with the rate of overflow. The two possible approaches to efficiency in separation of solids are to use physical methods of restraint or to rely on gravity separation. The relative merits of screening, stilling ponds or vortex action in separation are discussed. Reliability is taken to include safety and convenience in operation as well as the more direct meaning. The structure should be designed for a life in excess of 30 years. Power driven devices are best avoided unless adequate and regular maintenance is assured. Emergency by-pass arrangements should be made. A design of 1937 is illustrated and discussed as well as a high weir type overflow. More opportunity is afforded in designing large overflows on new sections of sewer; one such design is shown. No overflow should be located on sewers less than 18 in. dia. or of maximum flow less than 6 cusecs. For small overflows the storage type are suitable; with larger flows only limited storage is likely to be practicable.
W69-02107

MAINTENANCE OF STORM FLOW REGULATORS,
For primary bibliographic entry see Field 08C.
For abstract, see .
W69-02108

SECONDARY MOTIONS APPLIED TO STORM SEWAGE OVERFLOWS,
T. M. Prus-Chacinski, and J. W. Wielogorski.
In Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Storm runoff, *Overflow, *Design, *Model studies.
Identifiers: *Calculations, *Suspended solids.

A model was used to study the possibility of using the helical flow in short bends as a basis for the design of storm sewage overflows. For a short bend a convenient measure of the intensity of the helix is the angle between the circumferential direction and the direction of flow very near to the bed of the channel. Several expressions were developed to predict the value of this angle. There is evidence that in a bend longer than 0=90 the intensity of the helix decreases, and that eventually at 0=180 the direction of water near the bed reverses toward the outer wall. If a relatively short bend is followed by a second of opposite direction, the helix generated in the former suppresses development of the helix in the latter. However, an S channel may be more convenient to use and was therefore investigated. The symmetrical S shape of the channel was chosen so that a number of possible configurations of the relative positions of slots and overflows could be investigated by reversing the channel. Figures are included to show the bed load distribution both with slots closed and opened; the relationship between suspended load and flow through the slot; and the relationship between bed angle in the first bend and Reynolds' number in a semicircular channel. It is concluded that the results of the investigation may be used to design an effective and cheap storm sewage overflow.
W69-02109

ON MEASUREMENTS OF STORM-SEWAGE OVERFLOWS - A GRAPHICAL METHOD,
L. Schmitz.
Gesundheits-Ing, Vol 85, p 363, 1964.

Descriptors: *Storm runoff, *Overflow, *Flow measurement.
Identifiers: *Calculations, Bernoulli's theorem.

Owing to the inaccuracy and difficulty of existing methods of calculations for storm-sewage overflows, a graphical method has been developed, based on Bernoulli's equation. By this method not only can liquid flow through non-uniform pipes measured, but with the application of Bernoulli's theoreum the difference in pressure between the top and bottom ends of the pipe and/or the required section of such vertical tapered pipe can be calculated. Values for the pressure drop, throat diameter and throat length for a minimum pipe-fall of 0.5 per cent and for the friction coefficient of 0.15 and 0.30 in relation to the volume of flow and the head of water are given. Diagrams and tables together with a worked example support the author's method.
W69-02111

MEASUREMENT OF STORM WATER OUTLETS IN COMBINED SEWERS BY THE THROTTLE-PIPE PROCESS,
L. Schmitz.
Gesundheitsing, Vol 79, p 323, 1958.

Descriptors: *Storm runoff, *Outlets, *Overflow, Weirs, Instrumentation.
Identifiers: *Combined sewers, *Calculations.

After discussing the differences between storm-water overflows in combined sewers and straight vertical-flow weirs, the author gives diagrams for the calculation of storm-water overflows when the following pipe is designed as a throttle pipe.
W69-02112

STORM-WATER OVERFLOWS: THE OPERATION AND DESIGN OF A STILLING POND,
D. E. Sharpe, and T. W. Kirkbride.
Proc Instn Civ Engrs, Vol 13, p 445, 1959.

Descriptors: *Storm runoff, *Overflow, *Design, *Stilling basins, *Flow control, Water pollution, *Model studies.

In designing storm-water overflows, the use of stilling ponds has many advantages as it not only permits comparatively accurate regulation of the flow but also results in less polluting matter being discharged. Model experiments were carried out on the operation of stilling-pond overflows with a view to determining the conditions limiting chamber design and to deriving suitable design standards. The flow patterns within a stilling pond were first investigated and the limiting conditions deduced therefrom are presented in a simple form for design application. The applicability of the results to the performance of full-scale overflows is being studied.
W69-02113

DESIGN, CONSTRUCTION AND PERFORMANCE OF VORTEX OVERFLOWS,
B. Smisson.
Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Design, *Construction, *Overflow, *Model studies, Outlets, Storm runoff, Rainfall intensity.
Identifiers: *Suspended solids, Calculations.

Using hydraulic models, research was carried out on comparatively small tanks using rotary motion induced by the kinetic energy of the sewage. A considerable increase in the amount of solids concentrated in the foul-water outlet over that due only to gravity was found. The program covered devices with prototype retention times from 20 secs. to 20 min. with energy levels at inlet from 0.05 to 20 ft. lbs./lb. Two full-sized overflow chambers have

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been built and observed in operation for several years. The model separators tested were of three types. The largest separator is illustrated and described. The results obtained at a 5 min. retention time, with crude macerated sewage having a mean strength of 230 p.p.m. suspended solids, are shown. It was found that a very significant degree of separation took place. To achieve satisfactory conditions of flow many alterations in shape had to be made, in particular a deflecting wall alongside the in-coming sewer. Floating solids were easy to retain by dip-plate. The number of occasions on which the overflow operates per year and the duration of such occasions would give a better criterion for design than any estimate of what should be left in the sewer. A method of design based on statistical analysis of rainfall is given, which enables the designer to choose the size of overflow best suited for any particular site.
W69-02114

THE PROBLEMS OF STORM-WATER OVERFLOWS,
V. Stalmann, and G. Warg.
Gesundheitsing, Vol 81, p 257, 1960.

Descriptors: *Storm runoff, *Overflow, Design, Flow measurement.
Identifiers: *Storm sewers, *Calculations, *Capacity.

The authors discuss calculations of flow in pipes and the dimensions and design of storm-water overflows.
W69-02115

PROBLEM OF DESIGN OF INTERCEPTING DEVICES WITH OVERFLOW WEIRS IN COMBINED SEWER SYSTEMS,
G. Tison, Jr.
Int Assn for Hydraulic Res, 11th Cong, Leningrad, Vol 2, paper 2.11. 9 p.

Descriptors: *Overflow, *Weirs, *Design, *Storm runoff, Sedimentation.
Identifiers: *Combined sewers.

Problem of design of intercepting devices with overflow weirs in combined sewer systems; problem is considered in relation to transportation of sediment which is kept away from watercourse receiving sewer flow; theory and experiments in laboratory show that laterally designed weir to divert storm water peak flow directly into watercourse, is poor design as it also removes sediment and brings it into river.
W69-02117

HOW TO PLACE STORM SPILLWAY IN COMBINED STORM AND SANITARY SEWER SYSTEM,
G. Tison, and V. Vukmirovic.
Rev C, Vol 4, No 1, pp 7-11, 1966.

Descriptors: *Overflow, *Storm runoff, *Design, Sedimentation.
Identifiers: *Combined sewers.

How to place storm spillway in combined storm and sanitary sewer system; problem is considered in relation to transportation of sediment which is to be kept away from watercourse receiving sewer discharge; theoretical considerations and laboratory tests show that laterally designed spillways for diverting stormwater peak flow into watercourse did not perform satisfactorily; improved spillway designs are discussed and experimental results obtained are shown in diagrams.
W69-02118

HYDRAULIC ASSUMPTIONS IN CALCULATING STORM-WATER OVERFLOWS,
H. Wagner, and G. J. Kallwass.
Gas Wasserfach, Vol 101, p 660, 1960.

Descriptors: *Storm runoff, *Overflow, *Design, Hydraulics.
Identifiers: *Calculations.

The commonly used methods of calculation for storm-water overflows are not suitable for modern designs. The authors discuss conditions of flow, run-off curves, and the friction coefficient and give a diagram for calculation of flow conditions in different shapes of sewer. Sources of error are considered.
W69-02119

THE EFFECT OF DELAYED DISCHARGE ON THE CALCULATION OF STORM-SEWAGE OVERFLOWS,
G. Warg.
Gas Wasserfach, Vol 107, pp 85-89, 1966.

Descriptors: *Overflow, *Storm runoff, Discharge (Water), Design, *Hydrographs.
Identifiers: *Calculations, Munich (Germany), Capacity, Surface permeability, *Urban hydrology, Storage tanks.

The author discusses theoretically the effect of delayed discharge of rain water on the design calculations and measurements of storm-sewage overflows and gives a detailed account of the measurements which were carried out in the sewerage system at Munich to evaluate the effects on discharge capacity, intensity and duration of discharge, load on the receiving water, and dimensions of the sewerage system. He suggests the use of a specially-developed hydrograph system to calculate and allow for changes in permeability at peak flows and to assess the maximal area likely to be covered during rain storms. Tables and nomographs which are included can also be used to calculate the effects of delay on design calculations for storm-sewage plants and flood retention basins.
W69-02120

THE PROBLEM OF SEPARATION IN PLANNING SEWER SYSTEMS,
T. R. Camp.
J Water Poll Control Fed, Vol 38, No 12, pp 1959-1962, Dec 1966.

Descriptors: *Overflow, *Sewers, *Water pollution, Construction costs.
Identifiers: *Sewer separation, *Combined sewers, *Storm sewers, Suspended solids.

Sewers originally were constructed to drain cellars and land, and later were permitted to carry sanitary wastes. Many older cities in the United States have the combined type of sewer system and now face the need for separate systems for sanitary wastewater and stormwater. The costs are estimated to be $10,000-$20,000/acre ($25,000-$50,000/ha), not including the cost of possible repairs to storm sewers. Although only three percent of the annual wastewater production is discharged by combined sewer overflows, greater amounts of bacteria and suspended solids are dislodged by high flows after storms. Other methods proposed to alleviate overflow effects are not so effective as separation.
W69-02121

OVERFLOWS OF SANITARY SEWAGE FROM COMBINED SEWERAGE SYSTEMS,
Thomas R. Camp.
Sewage and Ind Wastes, Vol 31, No 4, April 1959.

Descriptors: *Overflow, *Storm runoff, Rainfall intensity.
Identifiers: *Capacity, *Interceptor sewers, *Combined sewers.

The author notes that it has been shown that the average dry weather flow of sanitary sewage is approximately equal to the runoff from a rainstorm having an intensity of about 0.01 in/hr. For interceptors having a capacity of 2 x dry weather flow, more than 90 per cent of sanitary sewage is discharged in the overflows with a rainfall intensity of 0.2 in/hr or more. With interceptors having capacity of 5 x dry weather flow, about 76 per cent of sanitary sewage is lost during rainstorms having an intensity of 0.2 in/hr and about 90 percent is lost during rainstorms having an intensity of 0.5 in/hr. Frequency of overflows indicate that one may occur every 5 to 6 days during summer with interceptors designed for 1.5 to 3 x average dry weather flow. Chart of frequency of overflows in days/mo vs. capacity of interceptors in terms of average dry weather flow and variable time of concentration.
W69-02122

IMPROVEMENTS IN SYSTEMS OF 'COMBINED' SEWERAGE,
R. C. Carter.
J Instn Sanit Engrs, Vol 49, pp 105-27, 1950.

Descriptors: Water pollution control, *Storm runoff, *Overflow, *Sedimentation, Sewage effluent, Sewage sludge.
Identifiers: *Combined sewers, *Storage tanks, Interceptor sewers, *Capacity.

The author discusses the possibility of reducing pollution caused by discharge of storm water from combined sewers. It would not be economical to build sewers large enough to carry the max. flow to be expected, for example once each year, but storm overflows which discharge to a stream when the flow exceeds 6 x dry-weather flow cause considerable pollution. Storm tanks are a more satisfactory method of dealing with storm water, as sedimentation can take place and the effluent when the tank overflows is of a less polluting nature. It is suggested that an existing combined sewerage system could be expanded by constructing large storm water balancing tanks at various points on the main intercepting sewer. Storm water could be stored in these tanks and discharged to the sewers as capacity is available. A method for calculating the required capacity of the storm water balancing tanks is shown in a table. In discussion, Bevan, E V., Ackers, G. L., and Towsend, G. B., all stated that the chief difficulty with the system proposed would be the removal of the sludge which would accumulate in the balancing tanks and might give rise to septic conditions.
W69-02123

IMPROVEMENTS IN SYSTEMS OF COMBINED SEWERAGE,
R. C. Carter.
Survr, Vol 108, No 3019, p 743, Dec 16, 1949.

Descriptors: *Storm runoff, *Overflow, *Weirs, Design, Pumping, Treatment.
Identifiers: *Storage tanks, Suspended solids.

The author states that storm overflow weirs are a illogical weakness in design and should be eliminated wherever possible. Overflow from storm tanks is much to be preferred to storm sewer overflows as the overflow from the tanks has been rid of virtually all settleable suspended matter. Author derives a procedure utilizing storm balancing tanks which take excess storm water from upper laterals and later return the flow by pumping. Thus the peaks are removed and all storm water ultimately gets treatment, either total or at least storm tank.
W69-02124

ESTIMATION OF THE FLOOD FLOW AND DISCHARGE COEFFICIENT IN SEWERAGE SYSTEMS,
T. Dimchev.
Trud Nauchnoizsled Inst Vodosnab Kanaliz San Tekh, Sofia, Vol 1, pp 53-78, 1964.

Descriptors: *Sewage treatment, *Discharge (Water), Rainfall intensity.
Identifiers: *Calculations, *Urban drainage.

Hydrological observations made in 1958-61 in a area drained by part of the Sofia sewerage syste

are reported and analyzed mathematically with reference to the dry-weather flow and to peak discharges and discharge coefficients in the main sewer, including the effects of surface detention of rain water (which varies with the intensity of rainfall), duration of rainfall (which is inversely related to the peak flow), and the free volume in the sewer.
W69-02125

POLLUTION CONTROL FOR STORM WATERS AND COMBINED SEWER OVERFLOWS,
D. D. Dunbar, and J. G. F. Henry.
Water and Pollution Control, Vol 105, No 11, p 41, 45, 47, 52-3, Nov 1967.

Descriptors: *Water pollution control, *Storm runoff, *Overflow, Design.
Identifiers: *Combined sewers, Capacity, *Intercepting sewers, *Storage tanks, Canada, United States.

Methods and practices in United States and Canada to improve combined sewer efficiency are discussed; problem of how large intercepting sewer capacities should be in relation to average dry weather flow in combined sewer system is dealt with; design of storm holding tanks.
W69-02127

TROUBLE-FREE COMBINED SEWERAGE SYSTEMS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02128

AKRON MONITORS COMBINED SEWER OVERFLOWS,
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02130

STORM WATER AND COMBINED SEWAGE OVERFLOWS,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02131

INTERCEPTING SEWERS AND STORM STANDBY TANKS AT COLUMBUS, OHIO,
J. H. Gregory, R. H. Simpson, and O. Bonney.
ASCE Proc, Vol 59, p 8, Oct 1933.

Descriptors: Design, Construction, *Overflow, *Rainfall intensity, *Water pollution.
Identifiers: *Storage tanks, *Interceptor sewers, Columbus (Ohio).

Design, construction, and operation of sewerage system extension which is to provide for estimated population of 643,000 in 1960; overflow of sewage to rivers and streams; relieving unsanitary conditions in Scioto River and in Alum Creek; intensity, duration and frequency rainfall curves; function of storm standby tanks; cost data.
W69-02132

COMBINED SYSTEM OF SEWERAGE WITH LIMITED RAW WATER INLET,
Walo Von Greyerz.
Trans of Int Conf on Sanit Eng, London, pp 170-80, 1924.

Descriptors: Pipes, Sewers, *Storm runoff, *Rainfall intensity, *Runoff forecasting, Drainage systems, *Intakes, Construction costs.
Identifiers: *Combined sewers, Capacity, *Cellar flooding.

The combined system of sewerage while having many advantages is at times criticized because of excessive cost on account of the large pipe sizes required to accomodate the maximum run-off from severe storms which are of short duration. Lack of attention to this condition results in flooded cellars. These objections may be overcome to a large extent by designing the inlets for a limited capacity which the sewer can accomodate and utilizing the storage capacity of the streets to hold the surplus runoff. The streets are thus temporarily flooded to a depth of an inch or two. When the rate of precipitation slackens the stored water quickly drains off through the inlets. This limitation of rain water inlets unites both the simplicity and efficiency of the combined system and two of the advantages of the separate system, namely freedom from risk of cellar flooding and reduced construction cost. Data are presented for the town of Falkenburg for which such a system was designed, taking into account the various street grades and resultant gutter capacities. The methods of computing rates of run-off, inlet sizes, etc. are given in some detail. The discussion disclosed that this method was also in use in India and Panama.
W69-02133

RATIONAL DETERMINATION OF STORM OVERFLOWS FROM INTERCEPTING SEWERS,
S. G. Hess, and F. G. Manning.
Sewage and Industrial Wastes, Vol 22, pp 145-53, 1950.

Descriptors: Design, *Overflow, Storms, Runoff.
Identifiers: *Interceptor sewers, *Combined sewers.

A method is described for designing intercepters for use with combined sewer systems based on dry weather flow and run-off of a selected storm.
W69-02134

STORM WATER OVERFLOW IN EXISTING COMBINED SEWERS,
H. Hoffman.
Bauamt Gemeindebau, Vol 31, p 269, 1958.

Descriptors: Design, Sewers, *Storm runoff, *Overflow, Sewage treatment, *Oxidation lagoons, *Hydraulic design.
Identifiers: *Combined sewers.

The author describes the design of a sewer section by which storm water up to a given dilution is retained and can be discharged to an oxidation pit before reaching the stream. Hydraulic requirements are discussed and a sketch plan is given.
W69-02135

WATER SUPPLIES AND SEWAGE DISPOSAL IN BERLIN,
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-02136

EQUIPMENT, METHODS AND RESULTS FROM WASHINGTON, D C, COMBINED SEWER OVERFLOW STUDIES,
C. Frank Johnson.
J Water Poll Control Fed, Vol 33, July 1961.

Descriptors: *Overflow, Design, Sewage treatment.
Identifiers: *Urban drainage, *Combined sewers, Washington, D.C.

The study provided city officials with engineering estimates of the actual overflows of sanitary sewage, both present and future, which were of great help in developing and promoting the program of sewerage improvements.
W69-02137

ADVANTAGES AND PROBLEMS OF COMBINED SEWERAGE SYSTEMS,
P. Kisser.
Gesundheitsing, Vol 81, 245, 1960.

Descriptors: Sewers, Design, *Storm runoff, *Overflow, Sedimentation.
Identifiers: *Combined sewers, *Capacity, *Storage tanks.

The author discusses the advantages of combined over separate sewerage systems and the design and dimensions of storm-water overflows and sedimentation tanks.
W69-02138

ASCE COMBINED SEWER SEPARATION PROJECT PROGRESS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02142

WEST HARTLEPOOL SEWERAGE SCHEME WILL CLEAN BEACHES,
J. S. Miles.
Munic Eng, London, Vol 141, p 47, 1964.

Descriptors: *Storm runoff, *Overflow, *Outlets, Pumping, Water pollution control, *Recreation facilities.
Identifiers: *Combined sewers, Great Britain.

Work is in progress on a major sewerage scheme for West Hartlepool C.B.C., aimed at cleaning up 3 miles of beach and inshore waters between Newburn Bridge and the mouth of the river Tees. West Hartlepool is sewered on the combined system, most of the borough being drained through 3 outfalls. The scheme will be carried out in 2 main stages, providing first for the reconstruction of the existing outfalls as storm-water overflows and the construction of 3 pumping stations together with means of mascerating the sewage, and second, if conditions in Hartlepool bay are found to be suitable, for the laying of a long outfall buried in the sea bed.
W69-02143

DESIGN OF RAIN OVERFALLS IN DRAINAGE NETWORKS AND SEWAGE TREATMENT PLANTS,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02144

EFFECT OF VARIOUS STORM-WATER PROTECTIVE MEASURES ON THE SEWAGE SYSTEM,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02145

FEASIBILITY OF COMBINED SEWER SYSTEMS,
C. L. Palmer.
J Water Poll Control Fed, Vol 35, 162, Feb 1963.

Descriptors: *Design, Storm runoff, Rainfall intensity, Water quality, Discharge (Water).
Identifiers: *Combined sewers, *Storage tanks, *Capacity.

Any properly designed and constructed combined sewer, without making use of the storm water storage, will produce results in the range of 98 per cent efficiency and any expenditure of public funds to improve its operation should not be made until necessity can be clearly shown. The adoption of the plan of designing storm water storage into combined systems to the extent possible or desirable, will increase the efficiency of any combined system correspondingly. Generally speaking, the designing of storm water storage into a combined system increases the cost very little. Adding this feature to an existing system would cost more but would still not be a major expenditure. Separate systems will discharge to the receiving waters with every storm exceeding 0.03 in/hr or about 89 times each year for the area studied, and the quality of the storm-water discharge will be objectionable and closely comparable to that from a combined system. Combined systems, designed to make use of 'volumetric

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storage' for the containment of storm water, and based on the volume of a 1-year storm, would discharge to the receiving water only from 3 to 5 times each year, with a duration of about 0.4 per cent of total time, which corresponds to an efficiency of about 99.6 per cent.
W69-02146

COMBINED SEWER OVERFLOWS,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02147

FREQUENCY OF FLOW OVER STORM-WATER OVERFLOWS AND STORAGE POSSIBILITIES IN THE SEWERAGE SYSTEM,
S. Pfeiff.
Gas Wasserfach, Vol 103, p 84, 1962.

Descriptors: *Storm runoff, *Overflow.
Identifiers: Capacity.

From investigations of the frequency of action of storm-water overflows, the factors which must be taken into account in calculations are discussed and the possibility and importance of increasing the storage capacity of the sewerage system are considered.
W69-02148

NEW PRINCIPLES FOR THE ARRANGEMENT OF STORM WATER OVERFLOWS,
S. Pfeiff.
Gesundheits-Ing, Vol 79, pp 208-13, 1958.

Descriptors: Storm runoff, *Overflow, Design, Construction.
Identifiers: *Combined sewers, *Calculations.

Variations in the requirements for storm water overflows in combined sewerage systems are discussed and the generally accepted process of calculation is described. The basic requirements of overflows and the extent to which these are met by modern methods of construction are considered.
W69-02149

NEW PROCESS FOR SIMPLE CALCULATION OF DILUTION VALUES FOR STORM WATER OVERFLOWS IN COMBINED SEWERAGE SYSTEMS,
S. Pfeiff.
Gesundheits-Ing, Vol 77, pp 74-7, 1956.

Descriptors: *Storm runoff, *Overflow.
Identifiers: *Calculations, *Dilution, *Combined sewers.

The author discusses the uncertainties involved in the usual processes for the calculation of storm water overflows with the help of fixed dilution figures. He recommends the use of local frequency curves based on rainfall statistics, from which in each case a value can be determined for the rainfall limit at which the overflow comes into action. He shows how the overflow and the dilution can be reliably calculated from this limiting figure.
W69-02150

UNDERFLOW SEWERS FOR CHICAGO,
Milton Pikarsky, and C. J. Keifer.
Civ Eng, Vol 37, No 5, pp 62-65, May 1967.

Descriptors: *Tunnels, *Tunnel construction, *Discharge (Water), *Construction costs, *Computer programs, *Overflow, Water pollution.
Identifiers: *Combined sewers, *Chicago (Ill), *Storage tanks, 'Mole' tunneling.

Chicago plans to use a tunneling mole to construct a large tunnel under the rivers and canals into which all of its combined sewers would discharge. The cost of building the tunnel, referred to as the 'underflow mainstream', using this method is $2 million less than that for the conventional open-cut method of construction. The underflow system was simulated by a computer study, the results of which are tabulated. It is felt that the underflow sewer will demonstrate the feasibility of constructing economically a detention resevoir to greatly reduce the river pollution cuased by overflows from combined sewers, far below the surface in public right of way, while providing the conveyance capacity to reduce basement and underpass flooding. It should also demonstrate the practicability of constructing an enlarged underflow mainstream system to serve the entire City of Chicago and the surrounding metropolitan area.
W69-02151

EFFECT OF STORM WATER ON THE SEWERAGE SYSTEM AND THE RECEIVING STREAMS,
F. Popel.
Kommunalwirtschaft, Vol 9, p 340, 1957.

Descriptors: *Storm runoff, *Planning, *Overflow, *Water pollution.
Identifiers: Urban drainage, *Combined sewers.

The author discusses, with special reference to planning of new towns, the effect on streams of storm water overflows in combined sewerage systems. Calculation of the permissible amount must be based on the annual amount of discharge and of polluting matter in it, the self-purifying capacity of the stream, and the use made of the stream water. Investigations are required into the condition of the storm water in modern conditions of traffic and efforts should be made to develop a reliable method of assessing the self-purifying power of a stream receiving sudden discharges of polluting matter.
W69-02153

EXTENSIVE SEWERAGE WILL CURB POLLUTION OF A BAY,
Frederick E. Potter.
Pub Works, Vol 95, pp 104-05, Oct 1946.

Descriptors: *Water pollution control, *Sewage treatment, Outlets, Estuaries, Construction costs.
Identifiers: *Combined sewers, *Interceptor sewers.

Article discusses the pollution problems encountered by the City of Portland, Maine. The municipality is subdivided into nine watersheds, all of which drain to tidal water outlets. The effect of tides plus combined sewerage discharge from the heavily populated areas around 'Back Cove' has created an undesirable situation. Initially, a master plan was developed in 1943 to eliminate pollution within this area by construction of interceptor sewers, pumping stations, treatment plant, and outfall sewer. Recently, construction was completed on the south shore of 'Back Cove' at an expenditure of approximately $1 1/2 million. Construction is expected to begin shortly on the remaining portions of the sewage treatment facilities around Back Cove Bay.
W69-02154

THE STORM-WATER COMPROMISE,
F. J. Ribbius, and G. Kragt.
Gas Wasserfach, Vol 103, p 498, 1962.

Descriptors: *Storm runoff, *Water pollution control, *Overflow, *Design, Sewage sludge, Pumping.
Identifiers: *Combined sewers, *Dilution, *Calculations, Capacity, *Netherlands.

On the basis of experience in the Netherlands the authors discuss the design of combined sewerage systems and suitable compromises between the requirements of sewage purification and prevention of pollution of streams, with special reference to the calculation of dilution and the design of storm overflows. To avoid the risk of pollution by stirred-up sludge at storm overflows, methods are developed for calculating the frequency of overflow and the relation of storage to discharge capacity with reference to the installation of rain-water pumps. Graphs for the calculations required for the application of these principles are given and their application to projects for combined sewerage systems is discussed.
W69-02155

IMPROVING THE EFFICIENCY OF EXISTING INTERCEPTORS,
Erik Riis-Carstensen.
Sewage and Industrial Wastes, Oct 1955.

Descriptors: *Storm runoff, Rainfall intensity, *Biochemical oxygen demand.
Identifiers: *Interceptor sewers, *Buffalo (N. Y.), *Suspended solids, *Storage tanks.

For the Buffalo New York area, author has derived a characteristic factor for a district 'Ch' which is a ratio of average dry weather flow (gpd) to the runoff (cfs) during a uniform rainfall of 1 inch/hr (Ch = d over c). Study of sewage quality or strength during a 0.55 inch/rain indicates flow doubled, suspended solids 4-5 times, BOD in ppm decreased about 1/3, but total load was higher. During the rain the flow was 5 times and the suspended solids rose to 1220 ppm over an average dry weather concentration of 186 ppm. Author stresses point that the biggest contributor to the suspended solids is the material deposited in the sewers themselves during dwf. Recommends that sewers be constructed to be self-cleansing and also favors small storm water tanks be located on laterals and branches, storm water collected would augment dwf and help keep sewers clean.
W69-02156

A FLOODED-TUNNEL INTERCEPTOR SYSTEM FOR THE METROPOLITAN ST LOUIS SEWER DISTRICT,
W. G. Shifrin, G. K. Hasegawa, and V. C. Lischer.

J Water Poll Control Fed, Vol 39, pp 313-333 1967.

Descriptors: *Drainage systems, *Storm runoff, Discharge (Water), Pumping, *Tunnels, Design, Construction.
Identifiers: *Interceptor sewers, *Combined sewers, *Urban drainage, St. Louis (Mo).

St. Louis, Mo., is divided into three main drainage areas, draining respectively to the Mississippi River, Coldwater Creek, and Sugar Creek. A new sewage works is to be constructed at Bissell Point to serve the northern part of the Mississippi River drainage area, where at present there is a combined sewerage system discharging untreated sewage and storm run-off direct to the river. The advantages and disadvantages of different types of interceptor sewer to carry the sewage to the treatment plant were studied, and it was decided to install the flooded-tunnel type, in which the sewage is allowed to rise in the wet well of the pumping station at the treatment plant to such a level that the upstream hydraulic gradient allows all diversion structures to operate with a free fall as in a gravity system. The design and construction of the interceptor system are outlined and the proposed method of operation, which will depend on river stage and weather conditions, is described in detail.
W69-02158

DIVERSION FACTORS FOR COMBINED SEWERS BASED ON SEWAGE AND STREAM ANALYSES,
R. J. Theroux, and R. L. Meek.
Eng News Rec, Vol 139, p 734, 1947.

Descriptors: *Storm runoff, *Overflow, Biochemical oxygen demand, Dissolved oxygen.
Identifiers: *Combined sewers, *Interceptor sewers, *Capacity.

A rational method of determining the diversion factor for storm overflow is described in which the organic load of the sewage, in terms of BOD, is balanced against the purifying power of the stream as indicated by the flow, deoxygenation, and reaeration consts., BOD, and dissolved oxygen content of the water above the point of diversion. The method enables the maintenance of safe dissolved oxygen contents in the receiving stream without providing unneeded interceptor capacity. The diversion factor should not be less than 1.5.
W69-02160

ONE CITY'S APPROACH TO THE PROBLEM OF COMBINED SEWAGE OVERFLOWS,
D. H. Waller.
Water Sewage Works, Vol 114, pp 113-117, 1967.

Descriptors: *Overflow, *Sewage treatment, *Chlorination, Discharge (Water).
Identifiers: *Interceptor sewers, *Storage tanks, Urban drainage, *Combined sewers.

A description is given of the design and operation of one of two retention tanks constructed to prevent overflows into Halifax Harbour from the 'Arm sewer', an interceptor sewer which drains the west and north-west sections of Halifax, Novia Scotia, which are served almost entirely by combined sewers. The tank, which has a capacity of 1 mil. gal, is provided with an aerated detritus tank through which dry-weather flow passes direct to the interceptor sewer after screening; but when flow in the sewer reaches a maximal level, passage through the detritus tanks is stopped, and the retention tank fills, providing 15-min detention at a design peak flow of 150 ft (3) per sec before overflowing to the Arm sewer. Arrangements are made for chlorination to continue as long as the rate of inflow exceeds the rate of outflow to the interceptor. If the intensity and duration of the storm are sufficient to fill the tank, the chlorinated sewage is discharged to the harbour.
W69-02161

COMBINED VS SEPARATE SYSTEMS OF SEWERAGE,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02163

SEWAGE WORKS DESIGN AND WET WEATHER FLOWS,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02164

CORRECTING STORM-WATER INFILTRATION, TONAWANDA, NEW YORK,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02165

REDUCTION OF HYDRAULIC SEWER LOADING BY DOWNSPOUT REMOVAL,
Gerald L. Peters, and A. Paul Troemper.
No further identification available.

Descriptors: *Sewers, *Overflow, Storm runoff.
Identifiers: *Downspouts.

Methods used and results obtained to correct overloading of sewers by disconnecting roof downspouts from sewer systems in Springfield, Illinois are described. A description of the system existing before the program was initiated is given; data from engineering studies is presented. After the downspout removal program was decided on for suburban Springfield, inspections were made and voluntary compliance by property owners reduced the problem. Administrative and technical problems of the program for the city of Springfield are described. Results of the program are given in tables and copies of letters used are included. Costs, complaints and reduction of the overflow problem due to the program are discussed.
W69-02166

DESIGN CONSIDERATIONS FOR SANITARY SEWER EXTENSIONS,
Mississippi State Univ., State College.
Lloyd R. Robinson.
Water Sewage Works, Vol 114, No 7, pp 250-254, July 1967.

Descriptors: *Design, *Sewers, *Storm runoff, *Overflow.
Identifiers: *Urban drainage.

The results of a study made for Kansas City to determine dry weather flows from housing developments, apartments, industries and commercial establishments are discussed. No wet weather flows were measured but in a study of the flow record at one sewage treatment plant serving a residential area, as little as 0.6 in. of rain caused the recorder capacity of 0.008 cfs/acre to be exceeded.
W69-02172

STORM WATER IN SANITARY SEWERS,
V. W. Sauer.
Sewage and Industrial Wastes, Vol 24, pp 116-70, 1952.

Descriptors: *Storm runoff, *Sewers.

Measures taken at Central Contra Costa Sanitary District, California, to prevent storm water entering the sewers designed to carry sewage and trade waste waters are discussed.
W69-02175

A STUDY OF STORMWATER INFILTRATION INTO SANITARY SEWERS,
Lloyd W. Weller, and Myron K. Nelson.
J Water Poll Control Fed, Vol 35, p 762, June 1963.

Descriptors: *Storm runoff, Surface drainage.
Identifiers: *Sewer infiltration, *Urban drainage, Kansas City (Mo).

This is a discussion of the conduct and findings of a study of a sewer district with a present population of 50,000 (70,000 ultimate) located in the metropolitan area of Kansas City, Missouri. The scope and objectives of this study as regards stormwater infiltration were: ' (1) to make a surface drainage survey of selected areas and a surface inspection of the main sewers to find if any conditions promote the entry of surface water into sanitary sewers, and (2) to collect and evaluate data on sewer use and sewage flows.' A total sewer flow of 104.33 mgd (0.0215 cfs/acre) is developed during large rain storms and it is concluded that 'even during a period of moderate precipitation the major portions of the flow are from sources other than the water-using plumbing fixtures in the residences and public buildings within the district.' During these periods the major source of sewer flow is ground water, presumably from foundations drains used throughout the district. Additional local factors influencing sewer flow are reviewed.
W69-02177

THE DESIGN OF STORM SEWERS,
J. G. Hendrickson, and T. K. Breitfuss.
Pub Works, Vol 87, No 2, pp 91-5, 1956.

Descriptors: Design, *Runoff forecasting, Rainfall intensity, *Storm runoff, Construction, *Intakes, *Outlets, *Manholes.
Identifiers: *Storm sewers, *Capacity.

The calculation of run-off, which is dependent upon intensity, duration, and direction of rainstorms and slope and condition of surface of area to be served, is a very important factor in design of storm sewers. Storm run-off formulae and calculation of run-off are discussed. The authors consider also the design and construction of different types of inlets and outlets for storm sewers, design and location of manholes, and the load-carrying capacity of sewer pipes.
W69-02178

STORM SEWER DESIGN BY THE INLET METHOD,
Albert B. Kaltenbach.
Pub Works, Vol 94, Jan 1963.

Descriptors: *Design, *Intakes, *Storm drains, *Rainfall intensity, Hydrographs, Flow measurement.
Identifiers: *Storm sewers.

The Inlet Method of Design for storm sewers was developed from a continuing research project on storm drains that has been carried on by the Johns Hopkins University for the past 13 years. The article reports this method has shown results closer to and more consistent with actual conditions than any other known design method. The 3 steps involved are (1) determination of peak flows to each inlet based on maximum 5 minute rainfall intensity; (2) attenuating the flow peak from sub-area as it moves down the pipe; and (3) summing each subarea hydrograph to determine the total hydrograph at the design point. A simplified procedure is given for the designs where many inlets are involved.
W69-02179

LEAVES WON'T CLOG THIS CATCH BASIN,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02182

STORM SEWER ENDS MAN-MADE FLOODS,
Alfred R. Pagan.
Amer City, Vol 78, p 87, Jan 1963.

Descriptors: *Storm runoff, Surface drainage.
Identifiers: *Storm sewers, *Urban drainage.

The Borough of Palisades Park, N. J., part of the metropolitan New York complex, had a storm drainage problem. How this problem was solved is described.
W69-02188

SPLIT LEVEL DESIGN FOR SEWER SEPARATION,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02192

HIGHWAY DRAINAGE AND EROSION CONTROL,
J. L. Sanborn.
Purdue Univ-Eng Extension Ser-Eng Bul 113, pp 68-73, 1963.

Descriptors: *Highways, *Drainage systems, Surface runoff, *Outlets.
Identifiers: *Storm sewers.

Principles involved in controlling erosion and providing proper surface drainage are reviewed; how to build adequate transverse slopes and longitudinal grades on roadways, collecting ditches along roadside, and stable outlets to established water courses is discussed.
W69-02193

GROUND WATER CONTROL FOR HIGHWAYS,
T. W. Smith.
Nat Res Council-Highway Res Bd-Res Rec, No 57, pp 35-52, 1964.

Descriptors: *Highways, *Groundwater, *Subsurface drainage, Design, Construction.

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Subsurface drainage procedures used in design and construction of highways in California are described; application, construction, and effectiveness of stripping and blanketing with permeable material, stabilization trenches, horizontal drains, and other specialized measures used for subsurface water controls are discussed; particular consideration is given to characteristics of permeable material.
W69-02197

PROGRESS TO DATE AND CURRENT WORKS AT GLENROTHES NEW TOWN,
G. A. Sutherland.
Instn Municipal Eng, J, Vol 94, pp 325-9, Oct 1967.

Descriptors: *Surface drainage, *Storm drainage, Storms, Flood control, *Design, *Sewers, Runoff, *Discharge (Water), *Hydrograph, *Construction costs, *Rainfall intensity.
Identifiers: *Storm sewers, *Urban drainage.

Glenrothes, the second new town in Scotland, designated under the New Towns Act of 1946, was designated to contain an area of 5,730 acres and a target population of 32,000. Shopping, educational, and housing provisions are briefly discussed. The complete system of foul and surface water catchments is gravity operated and it has not been necessary to resort to either pumping or tunneling to maintain the gravity system. Two catchments, one draining the northern portion of the town (3,550 acres) and one draining the southern portion (2,180 acres) are described. A once in ten-year storm which should produce bank-full conditions and flooding has been provided for by twenty acres of balancing pond capacity based on an average water depth of three ft. This provision is estimated to cost 60,000 pounds. Design considerations are discussed for foulwater sewers and for surface water sewers. Foulwater runoff was based on a future water consumption of 50 gal/head/day. Trunk and development sewers within housing areas were designed for a peak flow of 6 D.W.F. A discharge rate of 7 cumins/acre was calculated for 1/3 of the area; the remaining 2/3 discharging at the rate of 1 cumin/acre. The trunk surface water sewer was designed by the Road Research Laboratory's Unit Hydrograph method for a once per year storm. This method showed an 8% saving in cost over the previously used design method (M.O.H. rainfall intensity curve). Subsidiary sewers were designed using the rational method and Bilham's once per year storm. Continuing rainfall observation is expected to establish a rainfall intensity curve for the area.
W69-02199

SHORTCOMINGS AND POTENTIAL OF ZONING,
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-02200

EMPIRICAL MODEL FOR PREDICTING DRAINAGE SYSTEM PERFORMANCE,
P. A. Taylor, and D. G. Watts.
Am Soc Agric Engrs-Trans, Vol 10, No 6, pp 723-6, 729, Nov-Dec 1967.

Descriptors: *Drainage systems, *Design, Sewers, *Computer programs.

Effect of springtime weather patterns, soil physical factors, and drainage system geometry on optimum design drainage coefficient for sizing mains and submains was studied at Oregon Agricultural Experiment Station; study of Amity series is reported; development of computer programs for water table simulation.
W69-02201

STORM DRAINAGE PROBLEMS AND SOLUTIONS,
A. L. Tholin.
Pub Works, Vol 92, No 8, p 172, 1961.

Descriptors: *Planning, Cities, *Storm drainage.

In a paper presented at a conference on environmental engineering and metropolitan planning the author outlined the problems encountered concerning the estimation and disposal of storm drainage and discussed how these problems could be solved.
W69-02202

FUNCTION AND ORGANIZATION OF HIGHWAY DRAINAGE SECTIONS,
F. W. Thorstenson.
ASCE Proc, J Highway Div, Vol 91, No HW1, paper 4207, pp 49-54, Jan 1965.

Descriptors: *Highways, *Drainage, *Surface runoff.
Identifiers: *Storm sewers.

Basic function of highway drainage sections, as related to design of culverts, bridge waterway openings, storm sewers, and erosion control facilities, is described; services pertaining to drainage matters that normally confront highway department organizational structure is suggested; procedures for conducting drainage activities.
W69-02203

DESIGN OF STORM SEWER SYSTEMS,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02204

EFFECT OF USING CONTINUALLY SUBMERGED DRAINS ON DRAIN SPACINGS,
J. Wesserling.
J Hydrology, Vol 2, No 1, pp 33-43, 1964.

Descriptors: *Storm drains, *Plastic pipes, Construction, Drainage systems.

Solution of flow problem given by Kirkham (1958) has been worked out for submerged drains; some calculation examples show that under certain favorable conditions considerable increase of drain spacing can be obtained by using deep, submerged drains; installing of such drainage systems is possible when using plastic pipes; carrying out drainage works under wet conditions, as will be often necessary, may in some soils impair structural stability of soil surrounding pipes; it should be investigated in what measure this will be the case when using modern laying methods.
W69-02205

DRAIN THAT GREW AND GREW,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02206

SOIL AND WATER PROBLEMS ON BUILDING SITES,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02207

GRAPHIC STORM SEWER DESIGN,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02208

POLLUTION OF STORM RUNOFF IN THE DRAINAGE SYSTEM OF LARGE TOWNS,
G. Schigorin.
Vodosn Sanit Tech, Vol 2, pp 19-20, 1956.

Descriptors: *Water pollution, *Storm runoff, Rainfall intensity, *Biochemical oxygen demand, *Storm drainage, *Cities.
Identifiers: *Urban drainage, *Leningrad (Russia), *Suspended solids.

The author describes investigations into the condition of storm water flowing from the street drainage system of a district of Leningrad. The effect of rainfall of various duration and intensity on different types of streets is discussed and a table of maximum, minimum, and mean values for contents of suspended and volatile matter, oxygen demand, BOD in 5 and 20 days is given.
W69-02209

POLLUTION OF CITY SURFACE RUN-OFF WATER,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02210

EFFECTIVENESS OF THE INTERCEPTION OF SEWAGE--STORM WATER MIXTURES,
Walter G. Shifrin.
U of Missouri Bull, Eng Series Bull No 47, Vol 61, No 8, pp 8-12, Feb 12, 1960.

Descriptors: *Storm runoff, *Overflow, Water pollution control.
Identifiers: *Combined sewers, Calculations, *Interceptor sewers, *Capacity, *St. Louis (Mo.).

Since it is not economically feasible to intercept and treat all of sewage-storm water runoff mixture the study reports on determination of proper interception factor. Average daily sewage flow was converted to an equivalent rainfall of 0.007 in/hr/acre for the area drained by combined sewers. Peak sewage rate was taken as 136% of average or 0.0095 in/hr/acre. Graphs and charts show the author's derivation of number of hours per year sewage would be bypassed. Author's conclusion based on specific case of St. Louis with overflow going to Mississippi River are that selection of interceptor capacities in excess of peak dry weather flow rate will produce an insignificantly small increase in the effectiveness of pollution abatement at a significant increase in the initial cost of the facilities.
W69-02211

SEWAGE DISPOSAL IN THE REGION OF THE LOWER LAKE THUN,
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-02213

STORM-WATER OVERFLOWS,
R. B. Stegmaier.
Sewage Works J, Vol 14, p 1264, 1942.

Descriptors: *Storm runoff, *Overflow, Flow measurement.
Identifiers: *Combined sewers, Baltimore (Md.), *Suspended solids.

Studies were made of the storm water discharge from a combined sewer in Baltimore, Md., during six storms. The maximum amounts of volatile solids and of total solids occurred at the maximum rate of flow.
W69-02214

RELATIONS BETWEEN THE DEGREES OF DILUTION IN THE SEWERS AT THE STORM WATER OUTLET, AND IN THE RECEIVING STREAM,
F. Vomberg.
Gesundheits-Ing, Vol 74, pp 227-9, 1953.

Descriptors: *Design, *Storm runoff, *Overflow, Sewers.
Identifiers: *Calculations, Dilution.

The author discusses the calculations required in the design of storm water overflows and in the determination of their effect on the receiving stream.
W69-02220

STORM SEWAGE OVERFLOWS - A MAJOR POLLUTION SOURCE,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02221

URBAN DRAINAGE AS A FACTOR IN EUTROPHICATION,
Federal Water Pollution Control Admin., Cincinnati.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-02222

URBAN LAND RUN-OFF AS A FACTOR IN STREAM POLLUTION,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02223

CHARACTERIZATION, TREATMENT AND DISPOSAL OF URBAN STORM WATER,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02224

PESTICIDES AND OTHER CONTAMINANTS IN RAINFALL AND RUNOFF,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02225

THE QUALITY OF RAINFALL RUN-OFF WATER FROM A HOUSING ESTATE,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02226

STORAGE ROUTING METHODS OF FLOOD ESTIMATION,
E. M. Laurenson.
Instn Engr, Australia-Civ Eng Trans, Vol Ce 7, No 1, pp 39-47, April 1965.

Descriptors: *Flood forecasting, *Model studies, *Rainfall-runoff relationships.

Estimation of floods resulting from rain storms on catchment areas by means of routing rainfall-excess through computational model representing catchment storage is discussed; main methods and concepts necessary to understanding and use of new storage routing technique are reviewed; several concepts are illustrated in example of application.
W69-02243

A CATCHMENT STORAGE MODEL FOR RUN-OFF ROUTING,
E. M. Laurenson.
J Hydrol, Vol 2, pp 141-163, 1964.

Descriptors: *Surface runoff, *Rainfall-runoff relationships, *Model studies, Discharge (Water), *Hydrographs, Storms.

To determine the surface run-off resulting from rainfall-excess a catchment storage model was developed by dividing the area into sections of equal storage delay time. Run-off was routed through the catchment by taking the outflow from a section plus the rainfall-excess as the inflow to the next section. The average delay time was shown to be equal to the lag for a catchment, and an empirical relation was determined between the lag and the mean discharge for a particular flood. The procedure was applied to storm data recorded at the University of New South Wales, South Creek experimental catchment, and the results were compared graphically with actual surface run-off hydrographs. Satisfactory agreement was obtained except in cases where the hydrograph rise was small.
W69-02244

STUDY OF R R L HYDROGRAPH METHOD OF DESIGNING SEWER SYSTEMS,
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-02250

ON THE IMPORTANCE OF VOLUME DISTRIBUTION IN THE CALCULATION OF DRAINAGE SYSTEMS,
P. H. Rendsvig.
Gesundheits-Ing, Vol 84, pp 241-246, 1963.

Descriptors: *Drainage systems, *Runoff forecasting.
Identifiers: *Calculations.

The author discusses a graphical method for calculating the volume of run-off to be allowed for in sewerage systems. He compares his result, based on the summation equation, with the Schoenefeldt method.
W69-02254

NOTES ON CALCULATING FLOW OF SURFACE WATER IN SEWERS,
D. W. Riley.
J Instn Munic and County Engrs, Vol 58, No 20, pp 1483-94, March 29, 1932.

Descriptors: *Surface runoff, Rainfall intensity, *Sewers.
Identifiers: *Calculations.

Methods of computing runoff corresponding to various rainfalls; intensity-duration and area-time curves.
W69-02255

ANALYTICAL CALCULATION OF STORM-WATER FLOWS IN A LARGE CHANNEL SYSTEM,
G. Supino.
Wasserwirtschaft, Stuttgart, Vol 52, pp 122-126, 1962.

Descriptors: *Storm runoff.
Identifiers: *Calculations, Italy.

The author summarizes methods developed in Italy for the calculation of storm-water run-off. These can be applied to canals, sewerage systems, and natural watercourses. The various equations and their range of application are discussed.
W69-02271

PROGRESS REPORT ON THE STORM DRAINAGE RESEARCH PROJECT, JULY 1ST, 1959 TO JUNE 30TH, 1960,
W. Viessman.
Johns Hopkins Univ, Dept Sanit Eng Water Resour, Baltimore, 1960.

Descriptors: *Storm drainage, *Drainage, *Discharge (Water), *Runoff forecasting, *Rainfall intensity, Weirs, Rain gage, Flow measurement, *Storm runoff, Intakes, *Design.
Identifiers: *Baltimore (Md.), *Urban drainage.

Progress in the storm drainage research project at Baltimore, Md. (see Wat. Pollut. Abstr. 1960, 33, Abstr. No. 2011) is reported, including studies on the effect of slope on the peak discharge from small drainage areas, the effect of antecedent rainfall on the peak rate of run-off, and the relation between the maximum 5-minute rainfall intensity and the duration of the intense part of a storm; the analysis of rainfall and run-off data for the gauged inlet areas; the development of a standard weir for use in hydrological research. It is hoped that the analysis of data from the existing and proposed gauging stations will ultimately permit the development of a satisfactory procedure for predicting flows to storm-water inlets and designing the appropriate drainage system.
W69-02276

MAD RIVER, HUMBOLDT AND TRINITY COUNTIES, CALIFORNIA.
Corps of Engineers, Washington, D. C.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02280

LOWER CHARLES RIVER WATERSHED, MASSACHUSETTS.
Corps of Engineers, Washington, D. C.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02281

PAPILLION CREEK AND TRIBUTARIES, NEBRASKA.
Corps of Engineers, Washington, D. C.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02282

BEAR CREEK BASIN, SOUTH PLATTE RIVER AND TRIBUTARIES, COLORADO, WYOMING, AND NEBRASKA.
Corps of Engineers, Washington, D. C.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02283

COLORADO RIVER AND TRIBUTARIES, TEXAS, COVERING MOUTH OF COLORADO RIVER.
Corps. of Engineers, Washington, D. C.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02292

WILD RICE RIVER, MINNESOTA.
Corps. of Engineers, Washington, D. C.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02297

PECAN BAYOU, TEXAS.
Corps. of Engineers, Washington, D. C.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02298

PUBLIC WORKS AUTHORIZATIONS, 1968 RIVERS AND HARBORS - FLOOD CONTROL AND MULTIPLE PURPOSE PROJECTS - PART 4.

Hearings before the Subcommittee on Flood Control - Rivers and Harbors of the Committee on Public Works, U S Senate 90th Congress, 2nd Session May 14, 15, 16, 21, 22, and 23, 1968.

Descriptors: Legislation, *Florida, *Water resources, Water conservation, Water distribution, Canals, Levees, *Alabama, Floods, *Kentucky, Ohio River, Reservoir sites, Project planning.
Identifiers: Everglades National Park.

The reports on Florida projects continued. The next report considered water resources for central and southern Florida. The drought of 1961 to 1965 demonstrated the need for improving water conservation for urban and agricultural needs and for preserving the Everglades National Park. The recommended plan calls for modification of the authorized water resources project by (1) raising Lake Okeechobee levees, (2) back pumping excess waters from east coast areas, and (3) improving water distribution by constructing and modifying canals, levees, pumping stations, control structures and related works. The next report on the Alabama-Coosa River Basin revealed that the area was subject to periodic flooding. The recommended plan entails constructing a levee system, pumping plant and drainage structures for Selma and Selmont, Alabama. The report on Southwest

Jefferson County, Kentucky, indicated a flood problem caused by the Ohio River. The recommended plan calls for an earth levee along the Ohio River together with interior drainage facilities. The report on the Licking River Basin, Kentucky, indicated a lack of flood-free land suitable for economic growth. The recommended plan calls for: (1) Royalton Reservoir; (2) two channel improvements; (3) three flood retardation structures; and (4) land treatment measures. (Childs-Fla)
W69-02299

WATER-SUPPLY STRINGENCIES--FEATURES, ANTECEDENTS AND OBSTACLES TO RESOLUTION,
U. S. Geological Survey.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02330

TRENDS IN RESERVOIR CAPACITY AND USE,
U. S. Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-02336

EFFECTS OF CYCLONE BEULAH ON THE YUCATAN PENINSULA (SPANISH),
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02359

END OF CYCLONE BEULAH, MEXICO (SPANISH),
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02364

4B. Groundwater Management

BEHRENS V SCHARRINGHAUSEN (REASONABLE USE OF PERCOLATING WATERS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02004

GROUND WATER RECHARGE - CONSERVATION IN NASSAU COUNTY,
W. Fred Welsch.
J Amer Water Works Assn, Vol 52, p 12, 1960.

Descriptors: *Storm runoff, *Groundwater, Outlets, *Drainage, *Stilling basins, Chemical analysis.
Identifiers: *Surface permeability.

Ground water replenishment with storm water serves several purposes: (1) replenish ground water supply, (2) provide drainage outlets without long conduits, and (3) reduce size of conduits for storm water drainage. Recharging done in several ways: (1) for small areas large dia. diffusion pipe installed in caisso. fashion, (2) single basin recharge reservoirs, and (3) two unit basins, first one to act as settling basin and second as seepage or percolation basin. Designed on a 5 in. rainfall in 2 days which has a frequency of about 5 years. Runoff coefficients increasing as area develops and pervious area decreases. Seepage rates for area are approximately 24 gpd/sq ft or 1 mgd/acre. Analyses of storm water basins indicate chlorides of 2.4 ppm, iron 0.1 - 0.8 ppm and D.C. of 132 - 218 ppm. Phenols have been found where runoff is from pavements of bituminous tar material.
W69-02241

4C. Effects on Water OF Man's Non-Water Activities

PRESUMPTION OF GRANT OF ALL INTEREST.

La. Rev Stat Sec 9:2971 (Supp 1968).

Descriptors: *Louisiana, *Legislation, Contracts, Waterway, Canals, Highways, *Right of way, Railroads, Land tenure, Leases.

Any transfer or other contract affecting land fronting on a waterway, canal, road, or other right of way is conclusively held under this act to include all of the grantor's interest in and under such right of way in the absence of an express provision to the contrary. Where the grantor owns title to the fee of land on both sides of the right of way and grants the land on only one side, it shall be conclusively presumed that all the grantor's interest to the center has been granted in the absence of a contrary provision. No existing valid rights are affected by this act. (Childs-Fla)
W69-02039

SHORTCOMINGS AND POTENTIAL OF ZONING,
Lee Anthony Syracuse.
ASCE Proc, J Urban Planning Devel Div, Vol 93, No UP4, pp 53-62, Dec 1967.

Descriptors: *Highways, *Storm drains, Surface runoff.
Identifiers: *Storm sewers.

Broad aspects of zoning are discussed. A brief discussion of storm sewers in cul-de-sac easement lanes is included. Inverted crown roads or one-sided sewer installation with the street slightly slanted toward the sewer can be used.
W69-02200

FUNCTION AND ORGANIZATION OF HIGHWAY DRAINAGE SECTIONS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02203

SOIL AND WATER PROBLEMS ON BUILDING SITES,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02207

EFFECTS ON WINTER STORM RUNOFF ON VEGETATION AND AS A FACTOR IN STREAM POLLUTION,
Richard H. Sullivan.
7th Annual Snow Conf, Milwaukee, Wis, April 12, 1967 6 p.

Descriptors: *Chemical analysis, *Storm runoff, *Highways.

A determination of chloride content of storm water discharge from a section of the Kennedy Expressway in Chicago during the winter of 1966-7 was carried out. Methods and results are given. Salt from snow clearing operations can cause occassional high salt concentrations. Results of tests on storm water from an area in which Cargill's Carguard was used as a corrosion inhibitor are given. Other studies on the effect of chlorides on vegetation are discussed.
W69-02216

EFFECTS OF CONSTRUCTION ON FLUVIAL SEDIMENT, URBAN AND SURBURBAN AREAS OF MARYLAND,
M. G. Wolman, and A. P. Schick.
Water Resour Res, Vol 3, pp 451-464, 1967.

Descriptors: *Water pollution, *Storm runoff, *Sedimentation, Estuaries, *Recreational facilities.
Identifiers: *Urban drainage.

The problem of sediment pollution by run-off from building sites in Maryland is discussed. Sediment yields ranging from 140,000 tons per square mile per year on an open construction site to 1060 tons in an urban area with some development were found. The quantity of sediment from areas under construction is 2-200 times as great as that derived from comparable rural or wooded areas. Details of changes in the stream bed of Oregon Branch caused by sediment from a construction site are given and compared with an unpolluted reach of the stream. Costs arising from sediment pollution of reservoirs, estuaries and channels are discussed and the loss of recreational facilities is mentioned. Measures to control sediment pollution are suggested.
W69-02227

4D. Watershed Protection

COLLECTION AND PAYMENT OF ASSESSMENTS: EXPENDITURE OF PROCEEDS THEREOF AND OTHER DISTRICT FUNDS.

N C Gen Stat Sec 139-27 (1967).

Descriptors: *North Carolina, Legislation, *Administrative agencies, *Taxes, *Assessments, Costs, Government finance, Water resources development, Local governments.

Under Sec 139-27, an assessment against a landowner for a watershed improvement district may be paid in its entirety, upon election, and in the absence of such election, the landowner will be deemed to have elected payment by annual installments. Provisions are made for such annual installments. Receipts and specified collection procedures are required. Receipts are to be sent to the taxpayers. Watershed assessments are to be collected by the county tax collector, and paid over to the watershed improvement district. A limitation period is specified and all proceedings for watershed assessments are to be considered in rem. A form for the assessment receipts is provided. (Williams-Fla)
W69-02027

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification OF Pollutants

HOW TO ANALYZE COMBINED SEWAG STORMWATER COLLECTION SYSTEMS,
R. H. Stanley.
Water and Wastes Eng, Vol 3, No 3, pp 58-6 March 1966 and pp 48-50, April 1966.

Descriptors: *Hydraulics, *Biochemical oxygen demand, Rain, *Storm runoff, *Overflow, *Wat pollution, Drainage, Computer programs.
Identifiers: *Calculations, *Combined sewers.

Method of analysis proposed involves field measurement of system hydraulic characteristics a condition; using these hydraulic characteristics a past records of BOD levels and rainfall, overflo quantity and pollution contribution may be calc lated; proposed method is adaptable to analysis system or drainage area changes; it can be p formed economically and in relatively short peri of time; calculations involved can be handled means of digital computer.
W69-02159

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OBSERVATIONS ON DREDGING AND DISSOLVED OXYGEN IN A TIDAL WATERWAY,
Navy Underwater Sound Laboratory, Ocean Sciences Division, New London, Connecticut, and Cornell Univ., Ithaca, New York.
Charles L. Brown, and Robert Clark.
Water Resources Res, Vol 4, No 6, pp 1381-1384, December 1968. 4 p, 2 fig, 4 ref.

Descriptors: *Water pollution sources, *Dredging, *Bottom sediments, *Dissolved oxygen, Suspension, Turbidity.

Study of dissolved oxygen in Arthur Kill and Kill van Kull, Staten Island, New York, during dredging showed that resuspension of oxidizable bottom sediments caused DO reductions of 16-83%. The net seaward movement of water in the streams is very slow. Water remains in the same area about a week and is affected by 2 daily tidal cycles. Wastes are discharged into it at a steady rate; the decrease in DO is caused by resuspension of mud. Dissolved oxygen and secchi disc transparency data are presented in graphs. (Knapp-USGS)
W69-02363

5B. Sources of Pollution

RUTH V AURORA SANITARY DIST (POLLUTION ABATEMENT).
158 N E 2d 601-608 (111 1959).

Descriptors: *Illinois, Judicial decisions, Districts, Municipal wastes, Sanitary engineering, Water pollution, Sources, Disposal, Sewage treatment, *Nuisance (Water law), Sewage effluents, Public health, *Abatement, *Pollution abatement, Water pollution control.

Defendant was discharging untreated or inadequately treated sewage into the river. Plaintiff, a residential subdivision developer was denied permission to connect his subdivision to the sewer system on the ground that it was already operating beyond its capacity, and that increased sewage waste would violate existing rules of public health. Plaintiff sued for abatement of nuisance by establishment of improvements in the collection system and disposal plant. The court held that the abatement of a public nuisance at the suit of an individual to whom the nuisance causes a particular injury was a valid exercise of its jurisdiction, and that the pollution of a river in the above manner is such a nuisance. The selection of the particular method by which this must be done was left to the defendant's discretion. (Scott-Fla)
W69-02002

POWER OF CORPORATE AUTHORITIES TO PROHIBIT THROWING INTO RIVERS AND HARBORS SUBSTANCES DANGEROUS TO NAVIGATION OR TO PROPERTY; VIOLATION OF PROHIBITION AGAINST THROWING DANGEROUS OR INJURIOUS SUBSTANCES INTO SAVANNAH RIVER.
Ga Code Ann Secs 80-1268 and 80-9902 (1967).

Descriptors: *Georgia, Local governments, *Cities, *Navigable waters, Legislation, *Water pollution.

Sec 80-126 authorizes the mayor and aldermen of Savannah to prohibit under proper penalties the throwing or depositing in the Savannah River, or within the harbor limits, of any substance which they might consider dangerous to navigation or injurious to vessels or the property abutting the harbor. Equal powers are vested in the corporate authorities of other Georgia towns and cities with regard to navigable waters within their jurisdiction. Sec 80-9902 makes the master of any vessel from which a substance forbidden under Sec 80-126 is thrown into the Savannah River guilty of a misdemeanor. (Williams-Fla)
W69-02062

COMBINED SEWER OVERFLOWS,
Carlysle Pemberton.
Water Resources Engng Conf, ASCE, Milwaukee, Wis, May 13-17, 1963, 20 p, 2 fig, 14 ref.

Descriptors: *Overflow, Flow measurement, *Water pollution, *Biochemical oxygen demand, Storm runoff.
Identifiers: *Combined sewers, *Suspended solids, Chicago (Ill).

A study was made of flow rates and composition of overflows from a large combined sewer serving a residential area of 8.6 square miles with a population of 144,300. Overflows occurred during 1.7 per cent of the time, in a 14-month period when rainfall was about 75 percent of normal. Gross bacterial pollution was discharged during overflows, limiting the use of the receiving waters from a public health standpoint. Suspended solids concentration in the overflow was greater on the average than that of dry weather flow, with considerable variation associated with rainfall intensity and time since the last storm. The 5-day BOD concentration in the overflow averaged about one-half that of dry weather flow, and was found to decrease with time after overflow started. The total BOD load discharged during overflows was 2.5 times the dry weather BOD load for the same number of hours. By extension of the observed data, it is estimated that the BOD load resulting from combined sewer overflows accounts for about 19 per cent of the total BOD load in the canal system serving the Chicago area.
W69-02147

EFFECT OF STORM WATER ON THE SEWERAGE SYSTEM AND THE RECEIVING STREAMS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02153

EXTENSIVE SEWERAGE WILL CURB POLLUTION OF A BAY,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02154

THE STORM-WATER COMPROMISE,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02155

IMPROVING THE EFFICIENCY OF EXISTING INTERCEPTORS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02156

A BRIEF HISTORY OF POLLUTION PROBLEMS AND POLLUTION CONTROL IN THE CITY OF LONDON, ONT,
C. C. Rutherford.
Water Poll Control, Ont, Vol 105, No 5, pp 66-69, 71, 1967.

Descriptors: *Water pollution, *Storm runoff, *Overflow, Water pollution control.
Identifiers: *Combined sewers, Urban drainage.

An historical description is given of pollution problems and control measures in London, Ont., which by the late 1950's was served by 3 overloaded sewage works. Problems included gross pollution of the Thames River by overflows from combined sewers, run-off from septic-tank areas, and flows from industrial sources. Subsequent annexation led to the acquisition of 3 more works; one of the original plants has been closed down and the others have been expanded and modernized. In addition, an industrial waste control programme has been begun, and pollution of the river has been considerably reduced.
W69-02157

DIVERSION FACTORS FOR COMBINED SEWERS BASED ON SEWAGE AND STREAM ANALYSES,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02160

COMBINED VS SEPARATE SYSTEMS OF SEWERAGE,
A. R. Ward.
Survr, Vol 81, No 2093, pp 299-300, March 4, 1932.

Descriptors: *Storm runoff, *Water pollution, Pumping, Sewers, *Deposition (Sediments).
Identifiers: *Combined sewers.

Discussion of sewerage systems; river pollution by storm water; deposition of solids in main sewers; combined system; pumping.
W69-02163

STORM WATER IN SANITARY SEWERS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02175

ARE PROTECTED STORM WATER OUTLETS DANGEROUS TO STREAMS,
W. Passavant.
Gesundheits-Ing, Vol 75, pp 362-3, 1954.

Descriptors: *Water pollution, Storm runoff, *Outlets, Equipment.
Identifiers: *Storm sewers.

The author gives a brief survey of possible methods for reducing pollution by storm water with special reference to the use of centrifugal screens.
W69-02189

POLLUTION OF STORM RUNOFF IN THE DRAINAGE SYSTEM OF LARGE TOWNS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02209

POLLUTION OF CITY SURFACE RUN-OFF WATER,
G. G. Schigorin.
Vodosn Sanit Tekh, No 2, pp 19-20, 1956.

Descriptors: *Water pollution, *Storm runoff, *Cities, Rainfall intensity, *Storm drainage.
Identifiers: *Storm sewers, Suspended solids, *Russia, Urban drainage.

To study the polluting effect of run-off from paved areas, samples of storm water collected from the separate storm-water sewers in Vasileostrovsk, U.S.S.R., and of water from street rain receivers after paved streets had been washed with automatic sprinklers, were analysed; the results are tabulated. Marked fluctuations in the concentrations of suspended solids are attributed to the differing degrees of dirtiness of different streets. Heavy rain did not appear to reduce the polluting effect of later run-off, probably because pollution intensities at the points of origin (road sweepings, products of breakdown of pavements, and air-borne contaminants) were relatively constant. Surface run-off from cobbled streets with comparatively light traffic was much less polluting than run-off from asphalt-paved streets with heavy traffic. The need for preliminary treatment of such run-off to reduce pollution of the receiving streams is stressed.
W69-02210

EFFECTIVENESS OF THE INTERCEPTION OF SEWAGE--STORM WATER MIXTURES,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02211

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SEASONAL VARIATIONS IN SURVIVAL OF INDICATOR BACTERIA IN SOIL AND THEIR CONTRIBUTION TO STORM-WATER POLLUTION,
Dale J. Van Donsel, Edwin E. Geldreich, and Norman A. Clark.
Appl Microbiol, pp 1362-1370, Nov 1967. 4 fig, 27 ref.

Descriptors: *Bioindicators, *Storm runoff, *Water pollution, *Coliforms.
Identifiers: *Bacteriological sampling.

Survival of a fecal coliform (Escherichia coli) and a fecal streptococcus (Streptococcus faecalis var. liquifaciens) was studied through several years at shaded and exposed outdoor soil plots. Death rates for both organisms were calculated for the different seasons at both sites. The 90% reduction times for the fecal coliform ranged from 3.3 days in summer to 13.4 days in autumn. For the fecal streptococcus, 90% reduction times were from 2.7 days in summer to 20.1 days in winter. During summer, the fecal coliform survived slightly longer than the fecal streptococcus; during autumn, survival was the same; and in spring and winter the fecal streptococcus survived much longer than the fecal coliform. Both organisms were isolated from storm-water runoff collected below a sampling site when counts were sufficiently high in soil. Isolation was more frequent during prolonged rains, lasting up to 10 days, than during short rain storms. There was evidence of aftergrowth of nonfecal coliforms in the soil as a result of temperature and rainfall variations. Such aftergrowth may contribute to variations in bacterial count of storm-water runoff which have no relation to the sanitary history of the drainage area.
W69-02218

A STUDY OF LAKE MICHIGAN: CHEMICAL, BIOLOGICAL, AND PHYSICAL,
J. L. Verber.
Verh Int Verein Theor Angew Limnol, 1965, Vol 16, pp 29-46, 1966.

Descriptors: *Water pollution control, *Overflow, *Storm runoff, Chemical analysis.
Identifiers: Oil pollution, *Lake Michigan.

Comprehensive investigations were made to determine the present water quality in Lake Michigan and make recommendations for its preservation; some of the physico-chemical, bacteriological, and biological results are presented in tables and diagrams and discussed. Sufficient vertical mixing occurs during spring and autumn to distribute the chemical constituents uniformly throughout the water column. It is concluded that the lake is still oligotrophic but precautions must be taken to reduce the build-up of phosphates and nitrates in certain areas where municipal and trade waste waters are discharged, particularly in the southern basin where there appears to be a large semipermanent clockwise gyral which tends to prevent dispersal of nutrients from the basin into the rest of the lake; chemical and biological differences between the northern and southern basins also indicate that horizontal mixing is very slow. The zone of poor-quality water along the coast near waste outfalls varies in width depending on the meteorological conditions. Preliminary action has been taken to reduce pollution, especially that caused by storm-sewage overflows and by oily, phenolic, and other trade waste waters.
W69-02219

STORM SEWAGE OVERFLOWS - A MAJOR POLLUTION SOURCE,
K. H. Walker.
Wastes Eng, Vol 33, No 8, Aug, 1962.

Descriptors: *Storm runoff, *Overflow, *Water pollution.
Identifiers: *Combined sewers, Boston (Mass), New York (NY).

This editorial stresses the need for further study and data to aid in solving the problem of storm sewage overflow. 1946 studies using Boston rainfall records show that sewage systems designed to handle 2 to 3 times average dwf would overflow 5-6 days/mo. The study also showed that with rainfalls of 0.20 inches/hr., nearly 90% of sanitary sewage would be discharged untreated. A New York City study showed that 60 to 80% of the raw sewage flowing through combined systems is discharged into the receiving waters once or twice a week.
W69-02221

URBAN LAND RUN-OFF AS A FACTOR IN STREAM POLLUTION,
S. R. Weibel, R. J. Anderson, and R. L. Woodward.

J Water Poll Control Fed, Vol 36, pp 914-924, 1964.

Descriptors: *Water pollution, *Storm runoff, *Biochemical oxygen demand, *Turbidity, Chemical analysis, *Pathogenic bacteria, *Coliforms.
Identifiers: *Urban drainage, *Suspended solids, Surface permeability.

After reviewing briefly the work of other investigators on the composition and strength of run-off from urban areas, the authors describe a study carried out in part of Cincinnati, where about 37 per cent of the total drainage area is impermeable, the remainder being lawns, parks and gardens. The run-off had an average B.O.D. of 19 mg per litre, a chemical oxygen demand of 99 mg per litre, a suspended-solids content of 210 mg per litre, a turbidity of 170 units and a colour of 81 units. The run-off was also found to contain organic chlorides, which could be derived from pesticides, and large numbers of bacteria, although faecal streptococci exceeded faecal coliform organisms, indicating predominantly non-human pollution. The highest concentrations of all contaminants occurred within the first 15 min of the start of run-off. These results confirm that run-off should be taken into consideration when estimating waste loadings from urban sources, and the authors stress the need for further studies to estimate the strength of run-off under various conditions.
W69-02223

CHARACTERIZATION, TREATMENT AND DISPOSAL OF URBAN STORM WATER,
S. R. Weibel, R. B. Weidner, and A. G. Christianson.
Proc 3rd Int Conf Water Poll Res, Munich, 1966, Vol 1, pp 329-352, 1967.

Descriptors: *Water pollution, *Storm runoff, *Chemical analysis, Rain, *Coliforms, Recreation facilities, *Sewage treatment, Chlorination, *Biochemical oxygen demand, Sedimentation, *Groundwater recharge.
Identifiers: *Urban drainage, *Suspended solids, Long Island (NY).

The authors give further results of studies at Cincinnati, Ohio, on the polluting effect of run-off from urban areas, including investigations of the chemical composition of the rain falling on the study area. The rain water was found to contain, on average, 0.69 mg of inorganic nitrogen and 0.24 mg of hydrolysable phosphate, per litre; these concentrations exceed the threshold values found by other workers for the development of algal blooms. The rain water also contained about 0.28 microgram of organic chlorine compounds per litre; DDT, DDE, and benzene hexachloride were identified. Analyses of the run-off, as reported previously, showed its pollution potential, and the concentrations of coliform organisms exceeded the criterion of 1000 per 100 ml recommended for bathing waters. Preliminary laboratory experiments on treatment of the run-off showed that sedimentation alone was not effective in reducing the BOD and suspended-solids content. Sedimentation for 20 min combined with chlorination at a dose of 4.62 mg of chlorine per litre killed more than 99 per cent of the bacteria; when the supernatant liquor was dechlorinated, however, and kept at room temperature for 24-72 hours, there was aftergrowth of coliform organisms, though not of faecal coliform bacteria or faecal streptococci. This work is still being continued. On Long Island, N. Y., storm run-off is being disposed of successfully by infiltration through the sandy sub-soil to recharge the groundwater resources in the area.
W69-02224

PESTICIDES AND OTHER CONTAMINANTS IN RAINFALL AND RUNOFF,
S. R. Weibel, R. B. Weidner, and J. M. Cohen.
AWWA J, Vol 58, No 8, pp 1075-84, Aug 1966.

Descriptors: *Storm runoff, Sampling, *Water pollution, Data collections.
Identifiers: *Urban drainage.

Data on rainwater and rural runoff and updated statistics on urban runoff are presented; rainfall sampling was done in connection with urban storm water-runoff studies, by Cincinnati Water Research Laboratory; results of rainfall analyses on pesticides are discussed; subsequent to collection and analysis of rainfall samples reported, it was found that some materials adhered to stainless steel trays these materials can be removed by scrubbing with nonphosphate soap and solvent.
W69-02225

THE QUALITY OF RAINFALL RUN-OFF WATER FROM A HOUSING ESTATE,
R. Wilkinson.
J Inst Pub Health Engr.

Descriptors: *Design, *Rainfall intensity, Water pollution, Overflow, Storm runoff.
Identifiers: *Storm sewers, *Urban drainage.

Housing estate of 611 acres, housing density of 5 t 6 houses per acre, est. population of 12,500 separate sewage system with storm system designe on 3/4 in/hr and impervious area of .4. Rain included 131 storms over year period with greate rain 0.84 in/24 hr. period and most rains of sma intensity. Statement made that first flush more po luting than rest of storm, but that certain storm continued stronger than some of the first flushes other storms. Catchment basin washed clean b first flow of water.
W69-02226

EFFECTS OF CONSTRUCTION ON FLUVIA SEDIMENT, URBAN AND SURBURBAN AREA OF MARYLAND,
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-02227

REMOTE SENSING OF WATER POLLUTION,
Sacramento State College, Sacramento, Californi
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02285

POLLUTION AFFECTING RIPARIAN RIGHT IN DEFINED CHANNELS OR DEPRESSIO ON THE SURFACE OF THE GROUND,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02315

POLLUTION AFFECTING APPROPRIATI RIGHTS IN DEFINED CHANNELS OR DEPRE SIONS ON THE SURFACE OF THE GROUND,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02316

POLLUTION OF WATER IN DEFINED CHANNELS OR DEPRESSIONS ON THE SURFACE OF THE GROUND UNDER COMBINED RIPARIAN-APPROPRIATIVE SYSTEMS,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02317

POLLUTION OF WATERS UNDER THE SURFACE OF THE GROUND,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02318

POLLUTION OF WATER ON THE SURFACE OF THE GROUND BUT NOT IN DEFINED CHANNELS OR DEPRESSIONS,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02319

PROTECTIVE MEASURES AND THE TORREY CANYON,
New Mexico Univ.
A. E. Utton.
Boston College Ind and Com L Rev, Vol 9, No 3, pp 613-632, Spring 1968. 20 p, 99 ref.

Descriptors: *Oily water, Oil wastes, Water pollution, Water pollution sources, *International law, *International waters, Water pollution control, Oil, Oil industry, Beaches, Aquatic animals.
Identifiers: Contiguous zones, Territorial waters.

The article examines what actions may be taken by a nation to protect itself from oil pollution damage caused by tanker accidents such as the Torrey Canyon incident of 1967. There is general agreement that a state may take unilateral action within a 'contiguous zone' outside its territorial waters under some circumstances. The 1958 Geneva Convention on the Territorial Sea and the Contiguous Zone fixed the zone at 12 miles and severely limited the situations in which action might be taken. Measures to curb oil pollution in the Torrey Canyon incident were probably properly taken under standards allowing the prevention of infringement of sanitary regulation. It is submitted that the state may exercise whatever control is 'necessary' to precent infringement as long as the control is 'proportioned' to the danger threatened. It is also contended that the realities of the situation limited by concepts of necessity and proportionality should control actions rather than the inflexible 12 mile limit. Allowable action should include before the fact regulation to prevent accidents as well as measures taken afterward. The article concludes that the most desirable approach is to reduce the likelihood of such situations as the Torrey Canyon incident through international agreement on navigational aids, traffic routes, and restoration measures. (Kahle-Fla)
W69-02333

COAL MINING EFFECT ON BUSSERON CREEK WATERSHED, SULLIVAN COUNTY, INDIANA,
Indiana Univ., Bloomington.
Don M. Corbett, and Allen F. Agnew.
Water Resources Res Center, Rep of Invest No 2, 187 p, July 1968. 23 fig, 1 plate, 37 tab, 8 ref.

Descriptors: *Acid mine water, *Indiana, Water quality, Discharge (Water), Storm runoff, Hydrographs, Dams, Reservoirs, Acidity, Iron, Sulfates.
Identifiers: Busseron Creek, Wabash River, Sullivan County (Indiana).

The chemical quality of water in the Busseron Creek Watershed, tributary to the Wabash River, Indiana, was studied to determine the effects of acid mine drainage on water quality in 26 reservoirs being constructed by USSCS. Sedimentation damage from coal mining is not serious. Streamflow data were collected for 2 years and 450 chemical analyses were made. Adic water is found in Big Branch in which 26% of the drainage area is disturbed by surface mining, Buttermilk Creek, 7% disturbed, and Sulfur Creek, 12% disturbed. The acid is contributed by both surface and underground mining. The other streams in the watershed are relatively unaffected by mining and have good quality water. Flushing of the streambeds during high flow causes temporary high concentrations of mining waste pollutants. Magnitude and frequency of storm runoff affect acid concentrations in the watershed. Present mining operations contribute no acid, which originates in old waste piles and surface mining areas. (Knapp-USGS)
W69-02341

NUMERICAL STUDIES OF UNSTEADY DISPERSION IN ESTUARIES,
Massachusetts Institute of Technology, Cambridge, and Gibbs and Hill, Inc., Boston, Massachusetts.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-02346

THE VARIATION OF WATER TEMPERATURES DUE TO STEAM ELECTRIC COOLING OPERATIONS,
Vanderbilt Univ., Nashville, Tennessee, and Johns Hopkins Univ., Baltimore, Maryland.
John E. Edinger, Derek K. Brady, and Willard L. Graves.
J Water Pollut Contr Federation, Vol 40, No 9, pp 1632-1639, Sept 1968. 8 p, 4 fig, 3 ref.

Descriptors: *Water temperature, *Heated water, *Thermal powerplants, *Cooling water, Lagoons, Streams.

In a study of temperatures in an artificial lake constructed to cool water discharged from a generating station before returning it to the stream from which it was taken, it was found that water temperatures vary with time due to changing plant loading and meteorological conditions. The time-averaged temperatures as well as the amplitude of the plant temperature variation decrease with distance from the discharge area and approach the water temperatures that would result from meteorological influences alone. As part of a continuing research on condenser water discharge, a study of the combined influence of varying plant loading and meteorological conditions on water temperatures has been made to test various time-varying prediction methods. Derivation of exponential equations used and a sample problem are included. (Knapp-USGS)
W69-02350

EFFECT OF DROUGHT ON STREAM QUALITY IN NEW JERSEY,
U. S. Geological Survey, Trenton, New Jersey.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02352

RADIOACTIVITY IN MINNESOTA MUNICIPAL WATER SUPPLIES JULY-DECEMBER 1967.
Minnesota Department of Health, Division of Environmental Sanitation.

Radiol Health Data and Rep, Vol 9, No 10, pp 566-567, Oct 1968. 2 p, 1 fig, 2 tab, 1 ref.

Descriptors: *Radioactivity, *Surface waters, *Municipal water, *Minnesota.
Identifiers: *Beta radioactivity, *Alpha radioactivity.

Beta and alpha radioactivity of samples of 9 Minnesota streams used for municipal water supplies are tabulated. Analytical procedures are briefly described. All the water supplies analyzed are well below the maximum recommended radioactivity standards for drinking water. (Knapp-USGS)
W69-02358

RADIOACTIVITY IN NEW YORK SURFACE WATER, JUNE-DECEMBER 1967.
New York State Department of Health, Division of General Engineering and Radiological Health.

Radiol Health Data and Rep, Vol 9, No 10, pp 568-569, Oct 1968. 2 p, 1 fig, 2 tab, 2 ref.

Descriptors: *Radioactivity, *Surface waters, *New York, Strontium radioisotopes.
Identifiers: *Beta radioactivity.

Gross beta radioactivity is reported for 27 sampling stations and Sr-90 is reported for 2 stations in New York, June-December, 1967. The sampling program was initiated in 1955. The methods of analysis are briefly described and any anomalously high radioactivity levels are explained. (Knapp-USGS)
W69-02360

DIFFERENCE MODELING OF STREAM POLLUTION,
Oregon State Univ., Corvallis, and New York Univ., New York.
David A. Bella, and William E. Dobbins.
ASCE Proc, J Sanit Eng Div, Vol 94, No SA 5, Pop 6192, pp 995-1016, Oct 1968. 22 p, 11 fig, 4 tab, 4 ref.

Descriptors: *Water quality, *Estuaries, *Mathematical models, *Path of pollutants, Computer models, Digital computers, Tides, Water pollution, Dispersion.
Identifiers: Finite difference methods.

Finite-difference methods are developed for the numerical analysis of BOD and dissolved oxygen profiles confined to cases which may be treated as one-dimensional problems. Temporal and spatial variations of hydraulic parameters and sources and sinks of BOD and dissolved oxygen can be incorporated into the models developed. Results obtained by the methods developed compare favorably to the results of available analytical solutions. For estuaries, the methods are applicable to the analysis of the variations of BOD and dissolved oxygen profiles within a tidal cycle. Significant variations of these profiles from those obtained by the commonly used quasi steady-state approach are demonstrated. The spreading which results from the tidal velocity variation is shown to have a significant effect on the BOD and dissolved oxygen profiles. The methods developed should prove useful in studies of estuaries in which the tidal variations are large and the temporal variations in the strengths of the BOD and dissolved oxygen inputs are great. (Author)
W69-02367

DISPERSION PREDICTIONS IN NATURAL STREAMS,
U. S. Geological Survey and California Univ., Berkeley.
Hugo B. Fischer.
ASCE Proc, J Sanit Eng Div, Vol 94, No SA 5, Pop 6169, pp 927-943, Oct 1968. 17 p, 2 fig, 3 tab, 12 ref.

Descriptors: *Dispersion, *Path of pollutants, *Tracers, *Routing, Digital computers, Computer models, Radioisotopes, Gold radioisotopes, Computer programs.
Identifiers: Longitudinal dispersion, Copper Creek (Va.), Clinch River (Tenn.), Powell River (Tenn.), Coachella Canal (Cal.).

Data from longitudinal dispersion studies by radioactive tracer, conducted by the United States Geological Survey during 1959-1961, are reanalyzed using more recent techniques. Data from 10 tests in 6 streams are examined. Methods available in the literature for calculating dispersion coefficients from tracer data are reviewed, and different methods applied to the same data are found to yield different results. A new method (routing

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procedure) is proposed, which uses a computer program to determine whether a suggested dispersion coefficient for a given stream predicts downstream tracer passage from upstream data. If the prediction is not adequate, the coefficient is adjusted until the coefficient giving the most accurate prediction is found. The dispersion coefficients obtained by the routing procedure are used to test a theory for predicting dispersion coefficients, proposed by the writer in a separate paper. The predicted and observed coefficients agree within 30% in half of the tests, and in the remainder (including some highly nonuniform streams) within a factor of 4. (Author)
W69-02368

SELECTIVE EROSION OF SOIL FERTILITY CONSTITUENTS,
Wisconsin Univ., Madison, Dept. of Soils.
H. F. Massey, and M. L. Jackson.
Soil Sci Soc Am Proc, Vol 16, pp 353-356, 1952. 4 p, 1 fig, 5 tab.

Descriptors: *Eutrophication, *Nutrients, *Soil erosion, *Leaching, Erosion, Soil properties, Soil chemistry, Fertilizers, Soil groups, Water pollution sources, Regression analysis, Correlation analysis, Estimating equations, Wisconsin, Runoff, Organic matter, Nitrogen compounds, Phosphorus compounds, Potassium compounds, Ammonium compounds.
Identifiers: Fayette silt loam, Almena silt loam, Miami silt loam, Silt loams, Predictive equations, Available phosphates, Exchangeable potassium, Organic nitrogen, Ammonia nitrogen.

Runoff samples from experimental plots at four locations in Wisconsin were analyzed for total soil material, organic and ammonia nitrogen, available phosphorus, and exchangeable potassium. Correlation studies were carried out to relate selectiveness of the erosive process for a given fertility constituent to quantity of eroded soil and concentration of suspended solids in runoff. The relationship was found to be highly significant (probability level, 0.01), with multiple correlation coefficients of 0.63 for available phosphorus, 0.79 for nitrogen and for organic matter, and 0.87 for exchangeable potassium. Selectiveness of the erosive process for the four fertility constituents determined increases in the order: organic matter, organic and ammonia nitrogen, available phosphorus, exchangeable potassium. At average values of erosiveness encountered in this study, the eroded soil material contained 2.1 times as much organic matter, 2.7 times as much nitrogen, 3.4 times as much available phosphorus and 19.3 times as much exchangeable potassium as the soil proper. Analysis of regression equations derived by methods described by author indicate that these four silt loam soils fall in two classes, with Almena, 3% slope, and Miami, 9% slope, exhibiting less selective erosion, and two Fayette soils, 20% and 11% slope, exhibiting more.
W69-02370

5C. Effects of Pollution

LIABILITY FOR INJURY TO PROPERTY OCCASIONED BY OIL, WATER, OR THE LIKE FLOWING FROM WELL,
G. Van Ingen.
19 ALR 2d 1025-1045 (1951).

Descriptors: *Saline water, *Oil wastes, Natural gas, Oil, *Oil wells, Artesian wells, *Remedies, Judicial decisions, Damages, Pollution, Wells, Oily water, Legislation.
Identifiers: Gas wells, Salt wells, Sulfur wells, Injunction, Negligence.

Owners and operators of gas or oil wells are generally liable for injury to another's property caused by oil or water flowing from the wells. Liability of a lessee of oil or gas wells to the owner or lessee of surface lands embraced in the lease is limited to injury to parts of the land not essential to his operations. In addition, owners or operators of gas or oil wells are liable for injury to property caused by stream pollution. Liability is usually based on negligence or nuisance, although in a few cases it is predicated on statute. A few cases have extended liablity to include injunction as well as damages. Where several operators have contributed to the injury they have been held jointly, jointly and severally, or severally liable. Owners of salt or sulfur wells may be enjoined from depositing salt and sulfur into streams so as to pollute them or injure lower property. Owners of water wells have been held liable for allowing flow from the wells to injure lower land; but in cases where the water was allowed to flow into a natural watercourse without negligence or malice, no liability was found, even though a lower owner was injured. (Kahle-Fla)
W69-02011

LIBBRA V MT OLIVE AND STAUNTON COAL CO (LIABILITY FOR FLOODING AND CONTAMINATION).

29 111 App 2d 396, 172 N E 2d 813 (1961).

Descriptors: *Illinois, Watercourses, Damages, Flood damage, Crop production, Agronomy, Civil law, Judicial decisions, Value, Worth, Property values, Monetary worth, *Soil contamination, *Water pollution, Acid streams, Path of pollutants, Water pollution effects.

Plaintiffs sued defendant coal company for damages to their farm and its crops caused by slack, coal dust, and other debris deposited by defendant in a stream which ran through both parties' premises. Due to the occasional overflow of the stream over a period of several years, the debris was deposited in varying amounts at different places on plaintiffs' property. As a result, the land was made too acidic to grow crop; and because it was deposited at irregular intervals, it was difficult to farm portions of the premises where there was no debris. The court awarded damages to the plaintiffs. Damage to the land was assessed at the difference in value before contamination and after contamination. Damage to the growing, unmatured crops was assessed at the value of the crop as it was when destroyed with the right of the owner to mature and harvest it at the proper time. Recovery for damage to crops for three succeeding years was allowed because of the continuing damages caused by subsequent flooding and debris deposits. (Scott-Fla)
W69-02048

SEWAGE DISPOSAL IN THE REGION OF THE LOWER LAKE THUN,
W. Spring.
Gas Wasserfach, Vol 104, pp 1397-1398, 1963.

Descriptors: Pumping, *Storm runoff, *Overflow, *Water pollution.

Attempts to maintain the purity of Lake Thun, Switzerland, have resulted in communal sewage disposal. Owing to the geological position of the lake the sewage flows without pumping to the lower region, where it reaches the pumping station at Durrenast and is then pumped into the treatment plant at Uetendorf, near the Aare. Additional pumping stations are planned for Gwatt, Einigen, Spiez and Faulensee, and special reference is made to the problems of planning sewage works for the future, in which the population index should be considered. The author also discusses the effect of storm-sewage overflows on receiving waters.
W69-02213

THE EFFECT OF FRESH-WATER RUN-OFF ON A POPULATION OF ESTUARINE POLYCHAETOUS ANNELIDS,
A. N. Stone, and D. J. Reish.
Bull So Calif Acad Sci, Vol 64, pp 111-119, 1965.

Descriptors: *Estuaries, *Storm runoff, Water pollution, *Bioindicators.
Identifiers: California.

Studies were carried out over a period of 1 months on the effect of run-off from rainfall on species of estuarine polychaetes in Souther California. It was found that the worms were kille or reduced in numbers by rainfall in excess of 0. inch, but repopulation by larvae of the same sp cies occurred rapidly.
W69-02215

EFFECTS ON WINTER STORM RUNOFF O VEGETATION AND AS A FACTOR IN STREA POLLUTION,
For primary bibliographic entry see Field 04C.
For abstract, see .
W69-02216

A LAKE'S RESPONSE TO ITS ENVIRONMENT
Robert O. Sylvester, and George C. Anderson.
ASCE Proc, J of Sanit Eng Div, Vol 90, No SA Pt1, Feb 1964.

Descriptors: *Water pollution, *Recreation faci ties, *Runoff, Nutrients, Deterioration, *Storm r noff.
Identifiers: Dilution, *Urban drainage, Bacteriolo ical sampling.

Green Lake in Seattle, Wash., was studied to fi the causes underlying its heavy algae blooms a alleged condition of pollution so that its recr tional potential might be realized. Data were c tained on urban runoff, lake shore runoff, subs face inflow, algae populations, waterfowl, compo tion of sediments, effect of wind-induced curre on water quality, and requirements of compet recreational water uses. Water and nutri budgets are presented. Nutrient additions sust heavy algae blooms throughout most of the ye and little can be done to reduce these additio Bacterial contamination is directly related waterfowl populations. Changes in physical a chemical water quality are caused largely by al growth and decay. Recommendations are given the addition of low-nutrient city water for dilut purposes, for dredging, and for shoreline impro ments. It is recommended that increased quanti of storm water not be added.
W69-02217

RELATIONS BETWEEN THE DEGREES DILUTION IN THE SEWERS AT THE STO WATER OUTLET, AND IN THE RECEIVI STREAM,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02220

URBAN DRAINAGE AS A FACTOR EUTROPHICATION,
Federal Water Pollution Control Admin., Cin nati.
S. R. Weibel.
Preprint, July 1967.

Descriptors: *Eutrophication, *Storm ru *Overflow, Water pollution, Nutrients, Sew Sewage treatment, Grants.
Identifiers: *Combined sewers, *Urban drainag

Stormwater runoff and combined sewer overf as sources of water pollution, including nut contributions are discussed. Maps show future banization patterns and present distributio states and their communities served by comb sewer systems. Tables showing average concen tions and computed annual amounts of stituents, including nutrients, produced per sq mile by the several sources such as rainfall, munity sewage, urban stormwater runoff and bined sewer overflows, are presented. Thes dicate that all are significantly concentrate some respect as to warrant consideration in praising sources of pollution, particularly nutri In terms of relative production of nutrients per of area, community sewage heads the group lowed in order of decreasing unit productio

ombined sewer overflow, storm water runoff from residentialtcommercial area and rainfall. Urban ormwater runoff as a water resource is discussed. omments on studies and practices representing e variety of efforts to control pollution from orm water runoff or combined sewer overflows e presented. Treatment of extraneous flows in nitary sewers is also included. Government search contract and demonstration grant proams to provide assistance to qualified workers inrested in contributing to methods for control of orm and combined sewer sources of pollution are tlined.
69-02222

OME FORMS OF ABSOLUTE LIABILITY FOR ATER POLLUTION,
or primary bibliographic entry see Field 06E.
or abstract, see .
69-02321

ONTROLLING INDUSTRIAL WATER POLLUION: COLOR THE PROBLEM GREEN,
wa Univ. Law School.
or primary bibliographic entry see Field 05G.
or abstract, see .
69-02331

FFECTS OF SURFACE MINING ON FISH AND ILDLIFE IN APPALACHIA,
ureau of Sport Fisheries and Wildlife.
seph A. Boccardy, and William M. Spaulding, Jr.

ur of Sport Fisheries and Wildlife, Resource ublication 65, 20 p, June 8, 1968. 10 fig, 4 tab, 27 f.

escriptors: *Mine drainage, *Aquatic environent, *Fish, *Wildlife, Fishkill, Fish management, shing, Water quality, Appalachian Mountain Reon.

he effects of strip and surface mining on the fish d wildlife resources in eight Appalachian States ere studied during a tour of mined areas by mems of a team of specialists from six Federal agenes. Surface mining has caused extensive damage fish and wildlife habitats and populations. A total 832,605 acres of land have been disturbed; 81% which are in Ohio, Pennsylvania, and West Virnia. More than 5,000 miles of Appalachian reams and 13,800 acres of impoundments have en seriously contaminated by acid mine water, me of it from surface mining. Additional water s been adversely affected by tremendous quantis of silt and sediment. Reclamation of mined nds is needed. Three of the eight States visited in 65-66 had no laws requiring restoration of stripned lands, and other States needed stronger laws d more enforcement. Virginia and Tennessee ve since passed laws governing strip mining. eclamation as currently practiced in the Aplachian region does not adequately restore ned lands to minimal standards necessary to proct and improve fish and wildlife resources. uthor)
69-02356

SAMPLE DESIGN FOR INVESTIGATING IE EFFECTS OF STREAM POLLUTION ON ATER BASED RECREATION EXPENDIURES,
nnsylvania State Univ., Institute for Research on nd and Water Resources.
esley H. Long.
ater Resources Bull, Vol 4, No 3, pp 19-26, Sept 68. 8 p, 1 tab, 5 ref, 1 append.

escriptors: *Recreation, *Water pollution, *Cost alysis, *Water sports, Aesthetics, Attitudes, onomic impact, Public health, Safety, Regresn analysis, Sampling.

sample design is presented for selecting streams an investigation of the relation between water pollution and water based recreation expenditures. The design is a proportional sample of clusters of streams stratified in a two-way scheme. The clustering is achieved by sampling 7 1/2 minute topographical maps, and the stratification by using measures connected with water pollution to classify the clusters. The design is based on considerations of economy in data collection and computational efficiency. A distinctive feature of the design is that data collected are to be used in a regression analysis. Thus, the sample size is determined by trying to achieve a given degree of precision for the regression coefficients. (Author)
W69-02357

MOLYBDENUM AS A FACTOR LIMITING PRIMARY PRODUCTIVITY IN CASTLE LAKE, CALIFORNIA,
California Univ., Davis, Dept. of Zoology.
For primary bibliographic entry see Field 02K.
For abstract, see .
W69-02373

5D. Waste Treatment Processes

RUTH V AURORA SANITARY DIST (POLLUTION ABATEMENT).
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02002

WATER POLLUTION -- 1968, PART 1.

Hearings - Subcommittee on Air and Water Pollution, Committee on Public Works, U S Senate, 90th Congress, Second Session, pp 1-199, March 27, 1968. 199 p, 4 append.

Descriptors: Legislation, Air pollution, Water pollution, *Water pollution control, Water pollution sources, Water purification, *Sewage treatment, *Water rates, Eutrophication, *Waste water treatment, Waste water (Pollution).
Identifiers: *Federal Water Pollution Control Act.

Hearings of the subcommittee of air and water pollution taken on March 27, 1968 are covered. The matters before the subcommittee were the activities of the Federal Water Pollution Control Administration and water quality standards. The reason for the hearings was pending legislation on air and water pollution being considered by the full committee on Public Works. The hearing record reflects the status of states complying with federal water quality standards. Much of the material found in the record is concerned with municipal sewers and purification plant facilities. The appendix includes a listing of state water quality standards, the status of federal approvals, and a report of activities of the Federal Water Pollution Control Administration through June, 1968. (Crabtree-Fla)
W69-02063

MUNICIPAL SEWER SERVICE CHARGES.

Hearings - Subcommittee on Air and Water Pollution - Committee on Public Works U S Senate - 90th Congress, Second Session, pp 59-174, Mar 27, 1968.

Descriptors: *Cities, *Municipal wastes, *Financing, Municipal water, *Water rates, Water purification, Sewage treatment, Sewerage, United States, Community development, Sewage disposal, Local governments, Utilities, Water treatment, Water works.
Identifiers: *Sewage charges.

This article analyzes the fundamentals that require consideration when a municipality adopts a system of charges for the use of its sewer system and purification-plant facilities. It also presents a series of sewer-service charges in use in selected areas throughout the United States, and gives some indication of the sewerage system that they help finance. Also included is a study that shows how cities can design and operate their sewerage purification plants so as to make them centers of civic interest and places where people like to come and visit. The article was taken from the American City Magazine. (Crabtree-Fla)
W69-02064

MODERN SEWER-SERVICE CHARGES, PART I - WHY CITIES NEED THEM.

Hearings - Subcommittee on Air and Water Pollution - Committee on Public Works U S Senate - 90th Congress, Second Session, pp 67-71, Mar 27, 1968.

Descriptors: *Sewerage, *Financing, Taxes, *Tax rate, Water rates, Costs, Local governments, Cities, Tennessee, Environmental sanitation, Sewage, Sewage treatment, Sewage districts.
Identifiers: *Sewer-service charges, Chattanooga.

The reason for the use of sewer service charges is that they avoid taxes. The principle benefit is that the public does not like taxes but will accept a charge that pays for a service that it comprehends. Shifting the financial burden of sewerage works from ad valorem taxes to sewer-service charges results in a wider array of contributors. Churches, schools, and other governmental units which do not pay property taxes immediately become paying customers. Additionally, the homeowner pays more nearly in proportion to use and commercial users pay likewise rather than being taxed on assessed valuation. The service rates of Chattanooga, Tennessee are presented. (Crabtree-Fla)
W69-02065

MODERN SEWER-SERVICE CHARGES, PART II - SOME TYPICAL RATES.

Hearings - Subcommittee on Air and Water Pollution Committee on Public Works U S Senate - 90th Congress, Second Session, pp 72-77, March 27, 1968.

Descriptors: Iowa, Minnesota, Pennsylvania, Ohio, Florida, Wisconsin, *Sewerage, Financing, *Water rates, *Plastics, Pipes, *Tax rate, Cities, Sewage treatment.
Identifiers: *Sewer-service charges, Ames (Iowa), Anoka (Minnesota), Bethal Park (Pennsylvania), Circleville (Ohio), Hollywood (Florida), Kissimmee (Florida), Lorain (Ohio), Oshkosh (Wisconsin).

This part presents the sewer-service rates of eleven typical municipalities. Several systems of charging are utilized. These are: (1) cubic feet, (2) gallons, (3) facility, (4) fixture, and (5) flat rate. Also included in this part is a short article on how a plastic-pipe is useful in preventing salt-water infiltration. (Crabtree-Fla)
W69-02066

WATER POLLUTION -- 1968 PART I -- (MODERN SEWER-SERVICE CHARGES, PART 3, METERED VS FLAT).

Hearings - Subcommittee on Air and Water Pollution, Committee on Public Works, U S Senate, 90th Congress, Second Session, pp 78-81, March 27, 1968. 4 p, 4 tab, 5 ref.

Descriptors: *Rates, Sewage disposal, *Municipal wastes, Sewage districts.
Identifiers: *Sewage rates.

The merit of metered sewer-service charges as compared to the flat rate charge is discussed. 85% of water distributed today is metered, but only a slight majority of cities using sewer-service charges favor metered charges. Some of the reasons for this are: (1) There is no inexpensive and convenient

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sewage meter; (2) All of the water which flows through a customer's water meter does not find its way to the sewer; (3) Flat rates usually reduce administration costs; and (4) The difficulty of treating the sewage varies with strength as well as with volume. However, because flat rates are based on fixtures and not usage, metered rates yield revenues more nearly proportional to the volume of sewage. (Crabtree-Fla)
W69-02067

WATER POLLUTION -- 1968, PART 1 -- (MODERN SEWER-SERVICE CHARGES, PART 4, THAT ELUSIVE PERCENTAGE).

Hearings - Subcommittee on Air and Water Pollution, Committee on Public Works, U S Senate, 90th Congress, Second Session, pp 82-86, March 27, 1968. 5 p, 9 tab.

Descriptors: *Rates, *Sewage, Sewers, Sewage districts.
Identifiers: Sewer-service charges.

The practice of establishing sewer-service charges as a particular proportion of the water rate is examined. Generally, sewer-service charges are between 30% and 200% of the water rate. Primary attention is given to comparing various cities as to how their water rates compare with their sewer-service charges. The conclusion is that percentage rates mean little because dollars, not percentages of the water bill, construct and operate plants. (Crabtree-Fla)
W69-02068

WATER POLLUTION -- 1968, PART I -- (MODERN SEWER-SERVICE CHARGES, PART 5, PENALTIES HURT YOUR UTILITIES).

Hearings - Subcommittee on Air and Water Pollution, Committee on Public Works, U S Senate, 90th Congress, Second Session, pp 87-92, March 27, 1968. 6 p, 9 tab, 4 ref.

Descriptors: *Rates, Sewage districts, *Sewage.
Identifiers: Sewage rates.

Penalties for late payment of sewer service bills and discounts for early payments of these bills are treated. The argument is that both should be eliminated; the penalty because it denotes an overbearing attitude, and the discount because it evokes thoughts of a bargain basement. Enhancement of a city's 'corporate image' is achieved by eliminating penalties and discounts. (Crabtree-Fla)
W69-02069

STORM SEWAGE SEPARATION BY HELICAL MOTION,
C. H. Dobbie, and J. W. Wielogorski.
Survr Munic Cty Engr, Vol 127, No 3839, pp 141-159, 1963.

Descriptors: *Storm runoff, *Overflow, Weirs, *Model studies.

An improved storm-sewage overflow is proposed, incorporating bends in the channel which produce helical flow, separating heavier materials and allowing the less-polluting liquid to flow over a weir along the outer wall of the channel. Tests are being conducted on a hydraulic model, which is illustrated, and it is hoped to incorporate this type of overflow in an existing sewerage system soon.
W69-02090

WASTE TREATMENT PLANT MODIFIED FOR INCREASED SOLIDS LOADING,
A. J. Reisdorph.
Pub Works, Vol 96, No 4, pp 113-114, 1965.

Descriptors: *Storm runoff, *Overflow, Discharge (Water), Sewage treatment.
Identifiers: *Combined sewers, Spokane (Wash).

The primary sewage-treatment plant at Spokane, Wash., has been enlarged to provide adequate treatment for the recently-added load of industrial waste waters (mainly from packing houses). The additional equipment includes a preliminary aeration unit for grease removal, and increased clarifying and digesting capacity. A storm-water overflow device selects the upper and lower strata in the combined sewers, containing comparatively clean water and grit respectively, for discharge direct to the Spokane river.
W69-02110

THE TREATMENT OF STORM SEWAGE,
B. D. Steele.
Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Water pollution, *Storm runoff, *Overflow, *Automatic control, Sewage treatment.
Identifiers: *Storage tanks.

A prime objective of the virtual resewerage of an area of about 27,900 acres at Coventry is the elimination of pollution in the river system, which forms the headwaters of the River Avon. The solution lies in the building of Storm Balancing Stations. In time of rain all flows in excess of 3 d.w.f. are spilled off into mechanically scraped circular tanks. Sludge is evacuated to the sewer. The provision of additional tanks or other processes is feasible. The tanks are probably unique in that overflow to the tanks, operation of the scraping mechanism, continuous pumping of sludge, sampling, tank emptying to the sewer and rising main emptying are all automatic. Results are beginning to become available from one station. Conclusions are that if in the future a proportion of the flow in a foul sewer may be discharged directly to the river the device for separating the elements must be designed on a more scientific basis, and the solution may lie in the provision of storm balancing tanks.
W69-02116

IMPROVEMENTS IN SYSTEMS OF 'COMBINED' SEWERAGE,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02123

IMPROVEMENTS IN SYSTEMS OF COMBINED SEWERAGE,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02124

FOCUS ON RESEARCH. WATER POLLUTION RESEARCH AND THE MUNICIPAL ENGINEER,
A. L. Downing.
J Instn Munic Engrs, Vol 92, pp 185-188, 1965.

Descriptors: *Water pollution, Automatic control, Instrumentation, *Storm runoff.
Identifiers: *Combined sewers.

The work and publications of the Water Pollution Research Laboratory relating to problems encountered by municipal engineers are outlined. Brief details are given of recent investigations on the effects of pollution on fish; the oxygen balance in rivers and estuaries; the dispersion of sewage from coastal outfalls; the fundamentals of established sewage-treatment processes, and the development of instruments for their automatic control; the operation of extended-aeration plants; tertiary treatment for polishing sewage-works effluents; the inhibition of sludge digestion by detergents and certain industrial effluents discharged to sewers; and the composition and flow of storm sewage in combined systems.
W69-02126

STORM WATER AND COMBINED SEWAGE OVERFLOWS,
S. A. Greeley, and P. E. Langdon.
ASCE Proc, J Sanit Eng Div, Vol 87, No SA1, 1961.

Descriptors: *Storm runoff, *Overflow, *Water pollution, Storms, Sewers, *Biochemical oxygen demand, Sewage treatment, *Chlorination, *Pathogenic bacteria.
Identifiers: *Combined sewers.

Most of the larger and older cities in the U. S. A. are served by combined sewerage systems resulting in pollution of waterways through overflows during storms. Such pollution could be removed by complete separation of storm water and sanitary sewage by the construction of a new system of sanitary sewers, but this would be expensive and inconvenient and is therefore of limited application. The interception and treatment of the dry weather flow and the first flushings of storm water will reduce the volume of sewage discharged through overflows to about 3 per cent of the total sewage flow, and with complete treatment of the intercepted flow about 90 per cent of the BOD can be removed. Treatment of intermittent discharges from overflows by retention and chlorination to remove floating solids and bacterial contamination can also improve conditions in receiving streams at reasonable cost.
W69-02131

STORM WATER OVERFLOW IN EXISTING COMBINED SEWERS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02135

EQUIPMENT, METHODS AND RESULTS FROM WASHINGTON, D C, COMBINED SEWER OVERFLOW STUDIES,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02137

SEPARATE SYSTEMS-COMBINED SYSTEMS,
E. Kuntze.
Abwass Technik, Vol 17, No 1, pp 8-10, 1966.

Descriptors: *Sewers, Sewage treatment, Water pollution, *Storm runoff, *Overflow, Pumping, Groundwater, Velocity.
Identifiers: *Combined sewers.

The author discusses, on the basis of experience, the advantages, disadvantages and economics of existing sewerage systems and compares the efficiency of the separate system with the combined system. Taking into account the requirements for sewage treatment and prevention of pollution of streams, detailed information is given on how risk of pollution by storm-sewage overflows and rain water pumps can be avoided. Taking into consideration the availability of existing sewerage systems, receiving waters, and local conditions, the author suggests that it must be decided individually whether the separate or the combined system is preferable. Where a new sewerage system is to be installed and good ground-water conditions prevail, the combined system was found to be more economical and adaptable; however, where the velocity of flow is low and a higher water level is required, the separate system is preferable especially when mineral substances can be washed away by the storm-sewage system.
W69-02139

THE TRUNK SEWER SYSTEM AND THE SEWAGE-TREATMENT PLANT OF THE TOWN OF UTRECHT. HISTORY AND TECHNICAL LAY-OUT,
M. Lugt.
Ingenieur's Grav, Vol 77, G.1-G.7 and G.9-G.2, 1965.

Descriptors: *Sewage treatment.
Identifiers: *Combined sewers, Utrecht (Netherlands).

After outlining the events that led to the construction of sewage-treatment facilities at Utrecht, the Netherlands, the author gives an illustrated description of the combined sewerage system and new treatment plant. The plant, which is designed to serve a population of 400,000, provides treatment by high-rate biological filtration with recirculation of effluent. Sludge is digested in two stages, dried on beds and used as fertilizer; sludge gas is used in dual-fuel engines to generate electricity.
W69-02140

WEST HARTLEPOOL SEWERAGE SCHEME WILL CLEAN BEACHES,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02143

DESIGN OF RAIN OVERFALLS IN DRAINAGE NETWORKS AND SEWAGE TREATMENT PLANTS,
G. Mueller-Neuhaus.
Gesundsheits-Ing, Vol 71, pp 9-10, 149-52, May 1950.

Descriptors: Drainage systems, *Storm runoff, *Water pollution, Design, *Overflow, Sewage treatment.
Identifiers: *Urban drainage.

Design of rain overfalls in drainage networks and sewage treatment plants; considerable difference between run-off and sewage flow off with varying density of population; average pollutions of city waste water; degree of dilution required for sewage, diagrams, charts.
W69-02144

EFFECT OF VARIOUS STORM-WATER PROTECTIVE MEASURES ON THE SEWAGE SYSTEM,
W. Munz.
Schweiz Z Hydrol, Vol 28, pp 184-237, 1966.

Descriptors: *Storm runoff, *Sewage treatment, *Overflow, Biochemical oxygen demand, *Planning, Sewage effluent, Water pollution control, *Rainfall-runoff relationships.
Identifiers: *Combined sewers, *Storage tanks, *Calculations, Suspended solids.

The author describes the mathematical analysis of the effect and efficiency of various decisions which might be necessary in planning treatment for the flow from a combined sewerage system, and calculates the annual amounts of setteable solids and BOD which may be removed by various settings of storm-sewage overflows and volumes of storage tanks. Storage tanks are useful when high degrees of treatment are required. The relation between rainfall and run-off from various types of terrain, the duration of run-off, and the quality of sewage in a combined system are considered, and the relation between the required quality of final effluent and the volume of the aeration tanks in an activated-sludge plant are estimated.
W69-02145

ONE CITY'S APPROACH TO THE PROBLEM OF COMBINED SEWAGE OVERFLOWS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02161

THE TRUNK SEWER SYSTEM AND THE SEWAGE-TREATMENT PLANT OF THE TOWN OF UTRECHT. II. STORAGE CAPACITY OF SEWERS AND PUMP REGIME,
J. W. C. Wammis.
Ingenieur's Grav, Vol 77, G. 23-G.31, 1965.

Descriptors: *Flow control, *Pumping, *Sewers, Instrumentation.
Identifiers: *Combined sewers, Utrecht (Netherlands), Capacity.

The sewerage of Utrecht, Netherlands, is designed as a combined system. To obtain maximal efficiency of operation at the sewage works it is important to equalize the flow to the plant throughout the day, and this is achieved by utilizing the storage capacity of the sewers and by selecting a suitable relation between the capacities of the pumps in the various pumping stations and the numbers of hours during which they operate. The pumps are operated by remote control from the main pumping station at the sewage works.
W69-02162

SEWAGE WORKS DESIGN AND WET WEATHER FLOWS,
R. K. Williams, and C. G. Wells.
J Inst Sew Purif, Pt 3, 361, 1959.

Descriptors: *Design, *Storm runoff, *Sewage treatment, *Sewage effluent, *Waste dilution, Water pollution.

The design of sewage works is usually based on the estimated dry weather flow, and the authors consider that more attention should be paid to wet weather flows. They suggest that full treatment should be provided for all flows up to 3 times dry weather flow; that flows from 3 to 5 times dry weather flow should be screened and settled; and that flows in excess of 5 times dry weather flow should be screened. In all cases the by-passed sewage should be mixed with the fully-treated effluent to dilute it before discharge. The frequency of peak flows in Salisbury, Southern Rhodesia, is discussed. The probable polluting effect of the different degrees of treatment and the effect of the suggested requirements on the design of the various treatment units are considered.
W69-02164

DIVERSION AND TREATMENT OF EXTRANEOUS FLOWS IN SANITARY SEWERS,
L. W. Weller, and M. K. Nelson.
J Water Poll Control Fed, Vol 37, p 343, 1965.

Descriptors: Sewers, *Sewage treatment, Chlorination.
Identifiers: *Sewer infiltration.

In many sewerage systems, the maximal flows may be many times the average as a result of extraneous flows, defined as liquids entering the sanitary sewers through sources other than plumbing fixtures or process facilities. This may cause difficulties at the treatment plant, and the authors describe the facilities installed to divert and treat peak flows in the Mission Township district of Johnson County, Kans., in the Indian Creek district of Johnson County (see also Wat. Pollut. Abstr., 1965, 38, Abstr. No. 437), and in Kansas City, Mo. Peak flow are settled, skimmed, and in two cases chlorinated, before discharge, thus reducing possible pollution of the receiving streams.
W69-02176

OIL RETENTION IN STORM-SEWAGE PUMPING STATIONS AND STORM-SEWAGE TANKS,
A. Krauel.
Gas Wasserfach, Vol 108, pp 48-51, 1967.

Descriptors: *Design, *Pumping, *Storm runoff, Water pollution control.
Identifiers: Ruhr River (Germany).

A description, with diagrams, is given of the design and operation of various storm-sewage pumping works, which were installed at 60 points on the lower Ruhr against oil pollution. These works, and the oil separators incorporated, are designed in accordance with the total rainfall of the area. Special reference is made to a reinforced-concrete oil separator, installed at the inlet of a large earth reservoir to prevent pollution of the ground water.
W69-02181

INDUSTRIAL AND DOMESTIC WASTEWATER CONTROL IN THE MILWAUKEE METROPOLITAN DISTRICT,
R. D. Leary, and L. A. Ernest.
J Water Poll Control Fed, Vol 39, No 7, p 1223, July 1967.

Descriptors: *Sewers, *Sewage treatment, Water pollution.
Identifiers: *Storm sewers, Urban drainage, Milwaukee (Wis).

The Milwaukee Sewerage Commission provides wastewater collection and treatment facilities for the 18 municipalities located within the District as well as for 7 contract areas located within the drainage area. Industries are required to separate wastewaters for discharge to storm or sanitary sewers and where necessary to provide pretreatment. Separation of unpolluted and slightly polluted industrial wastewaters for discharge to storm sewers is stressed to reduce the volume requiring treatment. This philosophy is carried into the domestic wastewater area and separation is required on private property. Concentrated wastewaters which will not affect adversely the collection system or the treatment processes are accepted in the sanitary sewer system. Required industrial waste pretreatment facilities are therefore designed to remove prohibited materials from the wastewater and generally can be classed as primary treatment units.
W69-02183

A NEW WASTE DISPOSAL SYSTEM,
E. Lindstrom.
Tidskr varme- vent-sanit-o kyl-Tek, Vol 29, pp 211-213, 230, 1958.

Descriptors: *Sewage treatment, *Plastic pipes, Storm runoff.
Identifiers: *Storm sewers.

In the proposed system, sewage from toilets is discharged separately from other household waste water by means of a vacuum maintained in the sewer, using a very small quantity of water to rinse the toilet bowl and form a water trap. The small amount of highly-concentrated sewage obtained would receive conventional treatment. Small-diameter plastic pipes form adequate sewers and because of the vacuum present they may be laid at any gradient, even upwards. The remaining household waste waters can normally be discharged to receiving waters without treatment, using a similar sewerage system employing an hydraulic vacuum principle may also be used for discharge of storm waters and for conveying industrial waste waters to treatment plants.
W69-02185

EFFECTIVENESS OF THE INTERCEPTION OF SEWAGE-STORM WATER MIXTURES,
W. G. Shifrin, and W. W. Horner.
J Water Poll Control Fed, Vol 33, p 650, 1961.

Descriptors: *Water pollution control, *Sewage treatment, Storm runoff.
Identifiers: *St. Louis (Mo.), *Combined sewers, *Interceptor sewers, Dilution, *Capacity, Urban drainage.

To reduce pollution of the Missouri and Mississippi Rivers in the St. Louis metropolitan area, Mo., it is planned to provide primary treatment of sewage. Most of the sewerage systems in the area are of the combined type, and the authors describe the method used to determine the amount of the mixture of sewage and storm water which should be intercepted for treatment. As the Mississippi River provides considerable dilution and is not used for

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recreation nor as a source of water supply for some considerable distance below St. Louis, it is concluded that it is unnecessary to provide interceptor capacities in excess of the peak dry weather flow.
W69-02212

SOME PROBLEMS IN THE HYDRAULIC DESIGN OF SMALLER TREATMENT WORKS,
J. Lang.
J Proc Inst Sew Purif, Pt 5, pp 482-490, 1964.

Descriptors: *Hydraulic design, Sewage treatment, *Storm runoff.

The author discusses some of the difficulties encountered in designing small sewage works which have small dry-weather flows but may receive large volumes of storm sewage.
W69-02228

NO STORM-WATER BYPASS,
R. D. Leary.
Amer City, pp 93-95, Aug 1966.

Descriptors: *Sewage treatment, Equipment, *Storm runoff.

A sewage purification plant for Milwaukee is described in detail. Primary treatment is provided for an average flow of 60 mgd and can be expanded to a dwf of 120 mgd by the year 2000. Secondary treatment is also planned for the future. The plant is designed so that each part can handle the entire flow hydraulically. Any unit can be taken out of service for maintenance and the balance of units will handle the entire 320 mgd stormflow. Therefore no plant bypass is needed and no untreated sewage flows to the lake.
W69-02229

PUBLIC HEALTH ENGINEERING IN A NEW TOWN--PROGRESS AND PROBLEMS,
H. J. Lumley, H. B. Parker, and T. Steel.
Instn Publ Hlth Engrs J, Vol 66, pp 18-33, 1967.

Descriptors: *Surface runoff, *Discharge (Water), *Intakes, Sewage treatment.
Identifiers: *Combined sewers, Urban drainage.

This discussion on public health services in Crawley New Town, Sussex, includes a description of sewerage and sewage disposal facilities. The new sewerage system was designed to carry surface water directly to local streams and the river Mole; the only surface water to go into the foul sewer was to be that from the existing combined sewers. In practice this system has failed and the treatment works, which was designed to take a storm flow of 12 m.g.d., has, under extreme conditions, had to deal with 18 m.g.d. Penstocks had to be fitted to the sewer inlets to prevent flooding at the works, with the resultant 'backing up' of sewers in many parts of the town when these are closed. Various causes of the excessive storm flow have been suggested. The new sewage works provide treatment by the activated-sludge process, with diffused-air aeration. Sludge is digested and used as fertilizer on farmland. With an effluent standard of 15 p.p.m. suspended solids and 15 p.p.m. BOD to maintain and improve upon, it may soon become necessary to duplicate the works to deal with the sewage from a rapidly expanding population. The master plan for Crawley failed to make any provision for refuse disposal; as a result two unsatisfactory attempts have been made to establish controlled dumps. The first site had to be closed when liquor draining from it polluted a stream which developed heavy growths of sewage fungus. At the second site an attempt was made to terrace a hillside, but as a result of geological faulting local streams were again polluted. This situation has been alleviated by digging drainage trenches at the base of the hill to collect the effluent which is then pumped back up the hill side for treatment on land. This has not entirely removed the pollution or the accompanying smell of hydrogen sulphide, and as a further measure potassium permanganate, which precipitates the hydrogen sulphide, is leached into the streams. The cost of mechanical methods of disposal are at present prohibitive and a long-term plan for refuse disposal is not yet possible.
W69-02230

DWF OF 282,000 GPD FOR BRENTWOOD SEWAGE WORKS,
T. V. Martin.
Munic Eng, London, Vol 142, pp 1375-1376, 1965.

Descriptors: *Automatic control, Sewage treatment, Equipment, Sewage sludge, Sewage effluent, *Storm runoff.
Identifiers: *Storage tanks.

The new sewage works of Brentwood, Essex, replacing the Lapwater Hall works which served a population of 1500, is designed to serve a population of 8000, with a design dry-weather flow of 0.282 m.g.d. Flows in excess of 3 times this value are automatically diverted to storm tanks from which flows in excess of 6 times dry-weather flow are discharged to irrigation plots and smaller flows pass with the settled sewage to the percolating filters. The rate of recirculation of effluent on to the filters is also controlled automatically in relation to the rate of the incoming flow. Final effluent is discharged to grass plots but flows in excess of 3 times dry-weather flow are pumped direct to the river. Sludge is digested and dried on beds; liquor from the digestion tanks and drainage from the drying beds are re-treated with the influent sewage.
W69-02231

TURKEY CREEK SEWAGE PUMPING STATION,
W. E. Nusbaum.
Sewage Works, Vol 112, No 2, pp 58-62, Feb 1965.

Descriptors: *Water pollution control, *Storm runoff, *Automatic control.

Plant in conjunction with new diversion structure is part of plan for pollution control of Missouri River and will be located near mouth of Turkey Creek trunk sewer; sanitary sewage and industrial wastes will be intercepted and pumped through 48-in. force main to new sewage treatment plant located near confluence of Kansas and Missouri Rivers; storm flows will be bypassed directly to Kansas River; plant is equipped with five sewage pumping units of vertical, dry-pit type driven through direct connected intermediate shafting by electric drives mounted separately on main operating floor; pump operation, electrical supply and automatic features are described.
W69-02232

SOME APPLICATIONS OF RESEARCH IN THE DESIGN OF SEWERAGE AND SEWAGE-TREATMENT WORKS,
H. R. Oakley.
J Inst Sew Purif, Pt 1, pp 83-101, 1963.

Descriptors: *Storm runoff, *Runoff forecasting, Hydraulic design, Sewage treatment, Design, *Sewers, Equipment.

The author discusses some examples of the application of results of research to improve the design of sewerage and sewage-treatment facilities, including calculation of storm-water run-off, hydraulic design of sewers, design of sedimentation tanks and percolating filters, improved aeration in the activated-sludge processes, and methods for polishing effluents and for treatment of sludge. He points out that direct application of fundamental research to design is seldom possible, and an intermediate stage of development is usually necessary.
W69-02233

EMERGENCY ALUM TREATMENT OF OPEN RESERVOIRS,
W. R. Ree.
J Amer Water Works Assoc, Vol 55, pp 275-281, 1963.

Descriptors: *Storm runoff, *Treatment, Water pollution control, *Turbidity.
Identifiers: *Storage tanks.

The author describes experiences of the Department of Water and Power, Los Angeles, Calif., in the direct application of powdered alum to open reservoirs for reduction of high turbidities caused by storm run-off. This treatment has been found useful in emergencies, satisfactory results being obtained with alum doses of up to 85 p.p.m. It has also been used successfully for treatment of storm water before it enters the reservoirs. Experiments also showed that the storm water could be treated with liquid alum, and large storage tanks are being constructed at two sites for this purpose, to eliminate the need for mechanically driven feeders.
W69-02234

CONTROL OF POLLUTION FROM COMBINED SEWER SYSTEMS,
Paul W. Reed.
1965 Public Works Congress and Equipment Show, sponsored by Amer Public Works Assoc, Los Angeles, Calif, Aug 31, 1965. 10 p, 8 ref.

Descriptors: *Storm runoff, *Water pollution, *Overflow, Sewage treatment.
Identifiers: *Combined sewers, *Sewer separation, Storage tanks.

Data from several cities concerning amount of pollution due to storm water overflow from combined sewers is given. Disadvantages of separating sanitary and storm sewers as a solution for the problem are discussed. Combined treatment and holding facilities are suggested as an alternative and various types are described. (Synopsis of this paper published in Public Works, pp 112-113, Aug, 1966).
W69-02235

SOUTHEND-ON-SEA SEWAGE WORKS AND PUMPING STATIONS,
J. H. D. Sayle.
J Inst Sew Purif, Pt 3, pp 242-244, 1963.

Descriptors: *Sewage treatment, *Storm runoff, Pumping.

The pumping stations and sewage-treatment facilities for Southend-on-Sea, Essex, are described. Sewage is treated at Prittlewell by screening, removal of grit, and sedimentation before discharge to the Thames estuary; storm water is screened before discharge, and all screenings are disintegrated. Sludge is now digested before being pumped to the sludge farm at Barling. Provision has been made for returning water draining from the sludge farm to the main treatment plant, but in dry weather this effluent is used by farmers for crop irrigation.
W69-02236

TREATMENT OF MUNICIPAL WASTE WATER,
O. J. Schmidt.
SW Water Works J, Vol 48, No 5, pp 18-28, 1966.

Descriptors: *Runoff, *Water pollution, Sewage lagoons, Biochemical oxygen demand, Sewage treatment, Design.

The author discusses sources of pollution, including examples of pollution by run-off, and describes the performances of lagoons used for tertiary treatment at Peoria, Ill., at South St. Paul, Minn., and at Indian Creek, Kans. BOD removals during the periods studied ranged from 20 to 70 per cent. It is pointed out that it is difficult to assess the efficien-

cy of tertiary treatment in lagoons, which produce well-nitritied effluents, when the influent BOD changes from a carbonaceous to a nitrogenous nature. The high efficiency of tertiary treatment is illustrated by results from the plant at South Tahoe, Calif. Reduction of pollution by improvements in the design and operation of sewage works and by chemical treatment is considered briefly.
W69-02237

METHOD OF CLEANING SEWER SYSTEMS,
E. J. Storia, and R. L. Voda.
U S Patent 3,170,814 (to Terra Chemical Corp) Feb 23, 1965.

Descriptors: *Sewers, *Storm runoff.
Identifiers: Combined sewers, *Polymers.

It is claimed that storm-water and combined sewerage systems can be cleaned by adding a water-soluble, high-molecular-weight polyelectrolytic organic polymer, such as acrylic and methacrylic acid derivatives, to the catch basins in amounts of 0.1-1.0 gal. Rain water entering the system dissolves the polymer which acts as a coagulant for material in the sewer, and carries it through the system to discharge.
W69-02238

SAINT NICOLAS: TECHNICAL DESCRIPTION OF THE SEWAGE-TREATMENT WORKS,
M. Theinpont.
Techq Eau Assain, Vol 19, No 219, pp 29-40, and No 220, pp 29-40, 1965.

Descriptors: *Storm runoff, *Sewage treatment, Automatic control, Sewage sludge, Sewage effluent.

A detailed, illustrated description is given of the new biological-filtration plant at Saint-Nicolas, Belgium, which has been designed to treat a daily dry-weather flow of 10,800 m3 of sewage and industrial wastes, with provision for reception of 3200 m3 per hour during storm flows, half of which can receive complete treatment. The percolating filters may be operated with alternating double filtration and recirculation, and the final effluent is discharged from humus tanks to Paddeschootbeek. Sludge receives primary and secondary digestion, during which it is heated by heat-exchange units situated outside the tanks; after drying on beds, the digested sludge provides a useful fertilizer. The operation of the plant is controlled automatically from a central control room, and its flexibility is illustrated by appended flow diagrams.
W69-02239

SEWERAGE AND STORM-FLOW TREATMENT,
D. J. Weiner.
Water Pollut Contr Fed J, Vol 39, No 5, pp 741-746 39 ref.

Descriptors: *Surveys, *Storm runoff, Sewage treatment, Tunnel construction, Instrumentation.

A brief review of the 1966 literature on sewerage and storm-flow treatment is presented. Topics included are tunnel construction, economics of pollution control measures, specific sources of run-off pollution, sewer maintenance programs, and the use of television in sewer inspection.
W69-02240

IMPROVED SUBSURFACE DISPOSAL,
Public Health Service, Zuni, New Mexico, Indian Hospital, and Cincinnati, Ohio, National Center for Urban and Industrial Health.
For primary bibliographic entry see Field 05E.
For abstract, see .
W69-02287

MINE WATER RESEARCH; THE LIMESTONE NEUTRALIZATION PROCESS,
Bureau of Mines, Pittsburgh, Pa., Pittsburgh Mining Research Center.
E. A. Mihok, Maurice Deul, and C. E. Chamberlain.
Bur of Mines Invest Rep 7191, 20 p, Sept 1968. 14 fig, 7 tab.

Descriptors: *Acid mine water, *Mine drainage, *Water pollution treatment, *Neutralization, *Limestones, Aeration, Settling basins.

A pilot plant for treating mine drainage by neutralization with limestone was designed, fabricated, and operated by the Bureau of Mines. The process consists of producing a very fine (minus 400-mesh) limestone slurry, mixing the slurry with the mine water, aerating the resulting mixture to remove carbon dioxide and precipitate iron, and separating the solids from the liquid by sedimentation. A mine discharge of pH 2.8, containing 1,700 ppm total acidity, 36 ppm ferrous iron, and 360 ppm total iron, was treated at rates from 300 to 400 gpm. The treated water ultimately reached a pH of 7.4 and contained no detectable iron. The resulting sludge compacted to approximately 1/3 the volume of sludge from mine water neutralized with lime. The advantages of the limestone process, compared with the conventional lime process, are as follows: Widespread distribution and lower cost of run-of-mine, indigenous limestone; simplicity of plant design; reduced hazards and plant operating and maintenance costs accruing from the use of less reactive chemical agent; higher solids concentration of the precipitated sludge; and no deleterious effect caused by accidental over-treatment. While total process costs could not be determined, it is conservatively estimated that the cost of treating mine water by the limestone process is 1/3 to 1/2 the cost of the lime process, depending on the characteristics of the water to be treated and the availability and quality of limestone used.
W69-02293

A STUDY OF SLUDGE HANDLING AND DISPOSAL,
Federal Water Pollut. Control Admin., Washington, D. C.
R. S. Burd.
Fed Water Pollut Contr Res Ser Publication No WP-20-4, 326 p, May 1968. 74 fig, 17 tab, 451 ref.

Descriptors: *Sludge, *Sludge disposal, *Sewage treatment, *Water treatment, *Waste water treatment, Sludge digestion, Drying, Incineration, Sewage lagoons, Chlorination, Odor.
Identifiers: Sludge handling, Composting, Land disposal, Ocean disposal, Odor control, Pipeline transportation, Utilization.

The subject of water and wastewater sludge handling and disposal is discussed in detail. New approaches are suggested for use by researchers, design engineers, and operators of treatment facilities. A major conclusion from the report is that additional support should be given to the research and development of better ways to treat the solid portion of wastewaters, after separation from the liquid. Other major conclusions of the report are: (1) Standardized accounting and reporting procedures are needed. (2) Sludge handling and disposal should be integrated into the total wastewater treatment system. (3) Wastewater sludge disposal could be considered as a part of total solids-disposal system that includes refuse and other solid wastes. (4) Incineration is a promising ultimate disposal technique. (5) Mechanical dewatering systems are replacing more primitive dewatering systems. (6) There is a trend to ocean disposal of sludge by coastal or near-coastal cities. (7) Raw sludge handling is becoming more popular. (8) The cost of ultimate sludge disposal for most installations ranges from $5 to $55 per ton of dry solids.
W69-02294

WASTEWATER REUSE AT THE GRAND CANYON,
Arizona State Department of Health, Phoenix.
Edmund C. Garthe, and Wilfred C. Gilbert.
J Water Pollut Contr Federation, Vol 40, No 9, pp 1582-1585, Sept 1968. 4 p.

Descriptors: *Water reuse, *Reclaimed water, *Tertiary treatment, *National parks, Arizona, Irrigation.
Identifiers: Grand Canyon National Park.

Reuse of wastewater for general utility purposes has been practiced at Grand Canyon Village, Arizona, since 1925. The arid climate and the geology of the South Rim region led to water shortage as tourism brought increasing numbers of visitors. The reclamation plant, consisting of activated sludge treatment, anthracite coal filtration, and chlorination, has successfully produced water suitable for the flushing of toilets, boiler feed, cooling, and irrigation of shrubbery. The development of several new abundant sources of potable water has taken place and the future of the reclamation operation is being considered. (Knapp-USGS)
W69-02349

5E. Ultimate Disposal of Wastes

IMPROVED SUBSURFACE DISPOSAL,
Public Health Service, Zuni, New Mexico, Indian Hospital, and Cincinnati, Ohio, National Center for Urban and Industrial Health.
Ronald A. Popkin, and Thomas W. Bendixen.
J Water Pollut Contr Federation, Vol 40, No 8, Part 1, pp 1499-1514, Aug 1968. 16 p, 15 fig, 5 tab, 10 ref.

Descriptors: *Soil disposal fields, *Septic tanks, *Laboratory tests, Waste treatment, Soil physical properties, Biochemical oxygen demand, Chemical oxygen demand, Groundwater.
Identifiers: Dosing rate.

In testing the application of liquid waste to a soil, both continued hydraulic acceptance and quality of the percolate were considered. Laboratory studies revealed that hydraulic acceptance as measured by the rate of wetting new surface area in a progressive ponding situation is influenced by the frequency of applying waste, the volume of waste applied, and the quality of waste applied. The rate of development of wetted absorption area decreased with decreased frequency of application and improved quality of the waste applied. Within limits the efficiency of use of absorption area was improved with higher loading rates; that is, the rate of using soil did not increase as rapidly as the loading rate. The quality of the percolate improved with time after a relatively poor initial period. The results of these studies suggest that the design and operation of soil absorption systems can be improved through use of once-a-week dosing and/or by use of improved pretreatment without imperiling ground water quality.
W69-02287

A STUDY OF SLUDGE HANDLING AND DISPOSAL,
Federal Water Pollut. Control Admin., Washington, D. C.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02294

DEEP-WELL DISPOSAL OF WASTES,
U. S. Geological Survey, Washington, D. C.
William R. Walker, and Ronald C. Stewart.
ASCE Proc, J Sanit Eng Div, Vol 94, No SA5, Pop 6171, pp 945-968, Oct 1968. 24 p, 5 tab, 68 ref.

Descriptors: *Waste water disposal, *Injection wells, *Legal aspects, *Regulation, Hydrogeology, Permeability, Porosity, Water quality.
Identifiers: Compatibility (Injection water).

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Deep-well disposal as a method for pollution control in the U. S. is investigated to ascertain the degree of development of deep-well disposal, and the procedures evolved to control this mode of disposal are reviewed. Only 9 of the 45 states surveyed expressly prohibit or, as a matter of policy, actively discourage the method of deep-well disposal. Some type of disposal wells are presently in operation in 25 states. The two controlling conditions necessary for an operable deep-well disposal system are a suitable disposal stratum, and a waste physically and chemically campatible with the resident material in the disposal formation. Care must be taken to assure that the various benefits are balanced, and that one aspect is not protected in such a manner as to be to the complete detriment of others. State regulations are summarized and tabulated. (Knapp-USGS)
W69-02342

WASTE WATER DISPOSAL: SAN JOAQUIN VALLEY, CALIFORNIA,
California Dept. of Water Resources, Sacramento.
Elmo W. Huffman.
J Irrig and Drain Div. ASCE. Vol 92, No IR 2, Proc Paper 4847. pp 47-60, June 1966.

Descriptors: *Waste water disposal, California, *Farm wastes, Canals, Watersheds (Basins), *Drainage programs, Saline soils, *Salts, Water quality, Sumps, Consumptive use, Leaching, Drainage water, Evaporation, Transportation.
Identifiers: San Joaquin Valley (Calif.).

The California Department of Water Resources determined that the most predictable method for the disposal of agricultural waste waters from the San Joaquin Valley was transportation by canal. Initially the discharge point would be near the outlet of the Sacramento-San Joaquin Delta. Recreation and wildlife features will be incorporated where feasible. Legally, the Bureau of Reclamation must provide disposal for agricultural waste waters from the San Luis Unit Service Area. Quality safeguards will provide assurance that the waste waters will not degrade the receiving waters. Waste water disposal requirements will build up gradually to a peak of about one-half million acre-feet per year by 2020 and then should diminish as present salt concentrations are nearly all leached out and removed. (Affleck-Ariz)
W69-02383

5F. Water Treatment and Quality Alteration

SUMMARY REPORT ON THE RESIDENTIAL WATER USE RESEARCH PROJECT,
Johns Hopkins Univ., Baltimore, Md., Department of Environmental Engineering Science.
F. P. Linaweaver, Jr., John C. Geyer, and Jerome B. Wolff.
Journal of the American Water Works Assoc Vol 59, No 3, March 1967, pp 267-82, 3 Fig, 6 tab, 8 ref.

Descriptors: Public utilities, Water rates, *Water demand, *Water consumption, Social values, Risks, Water distribution, Evapotranspiration, Demand, Peak load, Future planning, Forecasting.
Identifiers: *Residential water consumption, *Water use patterns, Maximum daily water demand, Design curves.

To determine water use patterns and demand rates in residential areas and the major factors influencing residential water use, master metered, punched type recorder systems were installed to monitor continuously 41 homogeneous residential areas located in various climatic regions throughout the United States. It was found that residential water demands for any duration depend on the number of consumers, their normal domestic or household use, the average irrigable area of their lawns, the rate of evapotranspiration, and the quantity of precipitation. The maximum daily water demand can be estimated by calculating a value for potential evapotranspiration. In the absence of data, a value of .28 in per day is recommended. The formula and mathematical derivation for these calculations are discussed in some detail. The relationships developed provide an opportunity to evaluate the costs of designing to any level of risk. Several factors other than economic level and climate influence residential water use. Sprinkling demand, metered and flat rate areas, have significant influence on water use. A basis is provided for improved design criteria for water distribution systems, and may make possible the development of more equitable water rate structures. (Gargola-Chicago)
W69-02302

COMPREHENSIVE WATER SYSTEM PLAN,
Cornell, Howland, Hayes, and Merryfield, Seattle, Washington.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02303

STABILIZING MANGANESE AND IRON IN WATER, ACCORDING TO THE ILLIG TECHNIQUE (SPANISH),
Pedro J. Caballero.
Ingenieria Hidraulica en Mexico, Vol 22, No 2, pp 237-242, 1968. 6 p, 6 fig, 3 photo, 2 ref.

Descriptors: *Water quality, *Manganese, *Iron bacteria, *Groundwater, Water treatment, Water pollution control.
Identifiers: *Mexico, *Illig process.

The Illig technique was used to stabilize manganese and iron in water. This work was necessary because the groundwater in Mexico carries trace amounts of these elements which eventually leave their oxides to interfere with water meters and the distribution system. The presence of these elements also encourages the development of manganiferrous bacteria of the Cremothrix, Clonothrix, and Gallionella genus, which are objectionable because of their noxious odor and mucilaginous proliferation. These bacteria can be prevented by the addition of sodium hexametaphosphate (Illig process). This compound acts as dispersing agent, in colloidal form, of the iron and manganese oxide particles. (Llaverias-USGS)
W69-02351

5G. Water Quality Control

DEPARTMENT OF WATER AND AIR RESOURCES OF NORTH CAROLINA.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02013

PROBLEMS AND PROGRAMS IN WATER POLLUTION,
Murray Stein.
Natural Resources J, Vol 2, No 3, pp 388-415, Dec 1962. 12 p, 2 tab, 6 ref.

Descriptors: Federal-state water rights conflicts, *Water pollution, *Pollution abatement, Water quality, Permits, *State governments, Interstate, Interstate compacts, Interstate rivers, Water law, Administrative agencies, Legislation, Water pollution treatment, Treatment facilities, Standards, Water conservation.

The primary rights and responsibilities for controlling water rest with the states, as shown in the declaration of policy of the Federal Water Pollution Control Act. The modern approach to the problem of pollution is reflected in recent state statutes whose object is to preserve and improve water quality for all users and to accomplish this through an agency that represents all the affected interests in the state. Potentially, one of the most effective techniques for control of water pollution is a permit system under which discharges of wastes into any waters of the state are prohibited except as permitted by the agency after examination of plans, specifications and other data. The disregard of state boundaries by flowing waters has led to the formulation of interstate compacts for the prevention and control of water pollution. Nine such interstate compacts have received Congressional approval. (R. Smith-Fla)
W69-02033

PROBLEMS AND PROGRAMS IN WATER POLLUTION,
Murray Stein.
Natural Resources J, Vol 2, No 3, pp 388-415, Dec 1962. 17 p, 6 tab, 14 ref.

Descriptors: *Water pollution, Water conservation, Cost sharing, Water demand, Water resources development, *State governments, *Federal government, *Pollution abatement, Standards, Reasonable use, Prior appropriation, Riparian rights, Municipal wastes, Industrial wastes, Water quality, Sewage, Treatment facilities, Interstate compacts.

Although water has been in ample supply up until now, we may be at the dawn of an era when water of usable quality will be this country's most critical natural resource. This article discusses the nature of the water pollution problem, state and interstate programs, and the federal role in water pollution control. It is generally agreed that the objectives of a water policy for the individual states and the nation are: (1) the equitable apportionment of water among often conflicting demands; (2) the improvement of water quality; and (3) the stabilization of water flows and water supply. The concentration of population and industry in urban areas creates serious water pollution problems. Municipal waste treatment processes in use today were designed for the wastes of 40 years ago and no essentially new or more effective process has been developed since. A major need for pollution abatement is to develop new municipal waste treatment processes that will remove much more of the contaminants than is now possible. (Smith-Fla)
W69-02036

PLYMOUTH VILLAGE FIRE DIST V WATER POLLUTION COMM'N (WATER POLLUTION CONTROL).
167 A 2d 677-680 (N H 1961).

Descriptors: *New Hampshire, *Legislation, Cities, Sewage, Industrial wastes, Municipal wastes, Water law, Water pollution, Pollution abatement, *Water pollution control, Water quality, State governments, Local governments, Waste disposal, Sewage disposal, Sewage treatment, Water pollution sources.

Plaintiff appealed from a decision of the Water Pollution Commission denying a further extension of time in which to comply with an order to abate the pollution caused by the discharge of raw sewage or inadequately treated sewage from the plaintiff town's sewerage system. The Commission indicated that an extension would be granted only if the plaintiff took positive action toward making final plans for a disposal plant which would solve the waste treatment needs of the entire community. The court found that the plaintiff admittedly had no definite plans for the erection of a disposal plant and that the plaintiff had no present intention of taking any action to meet the pollution control requirements. The court dismissed the appeal and held that the Commission had not exceeded its powers in attaching a condition to the granting of the extension. (Smith-Fla)
W69-02050

WATER SUPPLY QUALITY CONTROL.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02060

THE ADSORPTION AND DEGRADATION OF INSECTICIDES BY LAKE SEDIMENTS,
Wisconsin Univ., Madison.
L. W. Newland, and G. Chesters.
PhD Thesis, University of Wisconsin Library, Madison, Wisconsin. Project OWRR-B-016-WIS.

Descriptors: *Gamma-BHC, *Degradation, *Adsorption, Isomerization, *Parathion, Anaerobic, Aerobic, 1st-order kinetics, *Hydrolysis, Alkali-catalysis, Adsorption-catalysis.
Identifiers: Simulated lake impoundments, *Insecticide pollution, *Adsorption by lake sediments, *Degradation in lakes.

For extraction of gamma-BHC from a lake sediment a 41:59 hexane:acetone mexture was used. Best recovery was obtained by shaking for 6 hours and repeating the procedure. The sample was partitioned into hexane by addition of water and analyzed directly by GLC. Adsorption of gamma-BHC on 8 sediments was affected by sediment and gamma-BHC concentrations, and organic matter and clay contents. As molecule is neutral, van der Waals and H bonding are likely adsorption mechanisms. Degradation of gamma-BHC in simulated aerobic and anaerobic impoundments showed anaerobic degradation was more rapid. In an aerobic system 15% added gamma-BHC was degraded in 2100 hours and alpha-BHC formed. In an anaerobic system, 90% was degraded in 2100 hours to alpha and delta forms. Thermodynamic stabilities are gamma-<alpha-<delta-<beta-BHC. Volatilization of gamma- and alpha-BHC curtailed isomerism to stable forms, but anaerobically some delta was formed. Isomerization leads to detoxification. Parathion hydrolyzes by 1st order kinetics. In aqueous systems t-half values were 2150, 3250 and 138 hours at pH2, 7 and 10. In sediments degradation is more rapid than predicted from aqueous systems and is catalyzed by adsorption. T-half values were 258 and 220 hours in nonsterile and sterile samples. Hydrolysis occurs at POC bond attached to phenyl ring.
W69-02074

PAPILLION CREEK AND TRIBUTARIES, NEBRASKA.
Corps of Engineers, Washington, D. C.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02282

ANALYSIS OF FEDERAL WATER POLLUTION CONTROL LEGISLATION, 1948-1966,
Cornell Univ., Ithaca, New York. Water Resources Center.
Leonard B. Dworsky.
Journal of the American Water Works Assoc., Vol. 59, No. 6, June 1967, pp 651-668, 14 ref.

Descriptors: *Water pollution abatement, Political aspects, Federal project policy, *Legal aspects, State jurisdiction, State governments, Research and development, Regulation, Costs, Financing, *Water management, Administrative decisions, Inter-agency cooperation.
Identifiers: Water Quality Act of 1965, Clear Water Restoration Act of 1966, Federal Water Pollution Control Act, Guidelines.

An attempt is made to set in perspective the general principles of water pollution control legislation. Until the late '30's the national policy was one of non-interference; states were given control over their own pollution. In 1946 a new major series of actions began, outlining strong federal action. The new basic policy reiterated the authority of Congress to exercise jurisdiction over the control of pollution. Primary responsibility for the program shifted from certain federal departments, and today rests with the Department of the Interior. The water pollution control legislation of 1948 has resulted today in the return to the idea of adoption of a comprehensive pollution control plan by the states with the provision that federal action can be taken in face of state inaction. Prior to 1961 federal water resource development agencies were not provided with general authority to store and regulate water but new amendments of 1966 have allowed them to participate in regional planning with the states. Other sections of the new water pollution legislations are also discussed: (1) interstate cooperation and uniform laws, (2) research, investigations, training and information, (3) grants for research and development, (4) grants for water pollution control programs, (5) grants for construction, and (6) the Water Pollution Control Advisory Board. Enforcement measures against pollution of interstate navigable waterways are discussed through changes that have taken place. Abatement action is reviewed with the relevant section of the Act discussed, and related legislation on regulations, executive orders, Secretary's Policy Guidelines and some of the more important ones illustrated. (Gargola-Chicago)
W69-02312

WATER-QUALITY CONTROLS THE PROBLEMS AND THE SOLUTIONS,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol. 3 Water Pollution and Quality Controls, 1967, pp 1-32.

Descriptors: *Water quality control, *Water pollution, Chemical oxygen demand, Color, Turbidity, Physical properties, Chemical properties, Taste, *Water properties, Dissolved oxygen, Acidity, Alkalinity, Temperature, Odor, Pollutants, *Legislation.

The chapter begins with a discussion as to the scope of this volume. Some definitions are then given, and water quality and pollution are distinguished. The physical and chemical properties affecting water quality, such as: dissolved oxygen, biochemical oxygen demand, acidity and alkalinity of water, solids in water, turbidity, color, temperature, taste and odor, and living organisms in water are then discussed. This is followed by a description of the natural quality of water. Sources and means of water pollution are next discussed leading into an evaluation of water quality. The chapter is concluded with a perspective on water-quality problems and a look into the history of water-quality control laws. (Watson-Fla)
W69-02313

WATER-QUALITY CONTROLS ENFORCEABLE IN COURTS UNDER STATE LAW,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3 Water Pollution and Quality Controls, 1967, pp 33-53.

Descriptors: *Riparian rights, *Water pollution, *Reasonable use, Water quality, Watercourses (Legal), Lakes, Surface waters, Marshes, *Invasion, Wastes, Sewage disposal, Streams, Dams, Backwater, Damages, Subsurface waters, Water law, State governments.

This introductory section of Chapter 13, Water-Quality Controls Enforceable in Courts Under State Law, first gives the general scope of the chapter. Then definitions of the terms watercourses, lakes, subterranean waters, surface waters, liability, and harm are given from the Restatement of Torts. There are two general theories upon which a person whose property is harmed by water pollution might recover: interference with land and private nuisance of impairing water control. Interference with land may be through trespass or private nuisance. Trespass involves the deposit of material upon the plaintiff's land which constitutes an interference with the exclusive possession and physical condition of the land. Private nuisance which results in interference with the private use and enjoyment of the land may result from objectionable odors in the water. Private nuisance impairing water quality suits are based on the plaintiff's riparian rights to the use of the water. The reasonableness of the use the defendant is making of the water is a basic issue, and substantial harm is always required. A showing of negligent, reckless or ultra-hazardous conduct by the defendant is only required when the invasion is unintentional. (Watson-Fla)
W69-02314

HYDROLOGIC RELATIONSHIPS AND WATER QUALITY,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp 124-133.

Descriptors: *Hydrologic cycle, *Water quality, Streams, Water pollution, *Watersheds (Basins), Lakes, Watercourses (Legal), Surface runoff, Channels, Subsurface waters, Percolating water, Riparian rights, Priorities, Competing uses, Reasonable uses.

Water pollution law now in existence in most jurisdictions ignores the hydrologic cycle and other scientific knowledge regarding the relationship and movement of water. For effective water quality control, water law should be established according to natural basins rather than individual lakes and streams. Suggested ways in which water quality and quantity can be legally controlled on a basin system rather than individual waterways are set out. The legal obligations owed by the residents of the basin to their neighbors should be determined by their relative positions on the hydrologic cycle. (Watson-Fla)
W69-02320

JUDICIAL REMEDIES AGAINST POLLUTION,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02322

DEFENSES IN WATER-POLLUTION LITIGATION,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02323

CONTROLLING INDUSTRIAL WATER POLLUTION: COLOR THE PROBLEM GREEN,
Iowa Univ. Law School.
N. William Hines.
Boston College Ind and Com L Rev, Vol 9, No 3, pp 553-611, spring 1968. 59 p, 277 ref.

Descriptors: Water purification, Water pollution, Water pollution sources, Effluents, *Industrial wastes, Legislation, *Pollution abatement, *Water quality, Thermal pollution, Water pollution control, Quality control, Acid mine water, *Standards, Federal government, State governments, Local governments, Cities, Administrative agencies.

Economic factors, not a lack of technical know-how, are the principle deterrant to cleaning up pollution. Facts and figures are related showing that industry is the worst polluter of our water supply, because its investment in treatment facilities yields an economic loss. Pollution from various industries is discussed. Federal water quality control legislation is discussed with reference to an emerging national water quality policy. This policy seems aimed at positive efforts to enchance water quality. The legislative provisions are outlined. The major portion of the article is devoted to a discussion of possible means of generating the huge capital investment necessary for pollution control. Raw economics does not provide adequate incentives for pollution abatement. Therefore, public regulation is required. Federal, interstate, state and local enforcement are discussed. The use of water quality standards is explained. Federal financial assistance programs include Small Business Administration grants and municipal waste facilities construction grants. Proposed incentive programs, distinguished from assistance programs, include direct payments and grants, special tax treatment

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and loans. Effluent charges would work to set economic forces in motion by exacting a charge from industries for the damage they do to the water supply. It is concluded that one of these programs or a combination thereof should be implemented soon to help solve the serious industrial pollution problem. (Williams-Fla)
W69-02331

COAL MINING EFFECT ON BUSSERON CREEK WATERSHED, SULLIVAN COUNTY, INDIANA,
Indiana Univ., Bloomington.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02341

06. WATER RESOURCES PLANNING

6A. Techniques OF Planning

COMPREHENSIVE WATER SYSTEM PLAN,
Cornell, Howland, Hayes, and Merryfield, Seattle, Washington.
Holly Cornell.
Journal of the American Water Works Assoc., Vol 60, No 2, February, 1966, pp 125-129.

Descriptors: Industrial demand, Water supply, Water demand, Administrative decisions, *Adoption of practices, Future planning, Forecasting, *Estimation, *Comprehensive planning, Project planning, Water supply, Water demand, Land use.
Identifiers: *Water system development.

The current emphasis on area-wide planning of all public facilities includes the need for the development of comprehensive plans for water systems. The primary purpose of the plan is to determine the facilities required to serve a given area during a given period. The overall planning for an area which should be completed and available before the water system planning starts should include: (1) the extent of the area to be served, (2) the land use and development plan for this area, (3) an estimate of the rate of growth, and (4) an industrial development forecast. Once the overall planning information has been assembled, the next step is to forecast the need for water. Accuracy of predictions for future water demand is difficult, especially for industrial needs. Methods of discovering future demand characteristics could be developed on other basis, but the key factor is that the results be related to the system plan so that it remains flexible. This same flexibility must be present in plans for the supply system development where the availability of sources of supply is difficult to estimate. The comprehensive plan needs to be presented in a concise fashion so that it can be readily understood and referred to. But beside this it must be flexible, constantly reviewed, and updated.
W69-02303

6B. Evaluation Process

FINANCIAL MANAGEMENT OF A WATER UTILITY,
City Water Board, San Antonio, Texas.
Stuart H. Bogue.
Journal of the American Water Works Assoc, Vol 60, No 3, March 1968, pp 267-273.

Descriptors: *Financing, Public utilities, Capital, Investment, Water management, Budgeting, Adoption of practices, *Administrative decisions, Comprehensive plan, Long-term planning, Short-term planning, Scheduling, Municipal governments, Assessments.
Identifiers: Guidelines, *Water budget, Algonac (Mich), Oak Park (Mich), Revenue bonds.

A well managed water utility needs revenue to meet operating and maintenance expenses, support an adequate depreciation fund, meet all interest charges, and amortize outstanding indebtedness. Funds are also necessary to provide a surplus to pay for ordinary capital additions and emergencies, and to attract investment capital for major expansion. Two types of bonds are used to finance municipal projects, general obligation bonds, and revenue bonds. Each of these have advantages, and the use of either may be dictated by the particular situation. New system financing possibilities are discussed and the problem of special assessments considered. Illustrations of inefficient financial management are given through examples of two smaller communities. To aid these and other communities in developing efficient financial systems for water utilities, a program of development and budgeting is outlined. Briefly stated the points are: (1) development of a comprehensive plan that encompasses every aspect of the water departments potential for physical and fiscal development, (2) long-range plans that project operating needs, (3) short-range plans that bring into focus the need for limited scope improvements, (4) long-term fiscal plans. To maintain the planning effort a realistic budget should be established, including: (1) a system for organization, (2) an accounting system, (3) a performance data system, (4) a scheduled budget, and (5) a clear departmental framework within which budgeting responsibilities are assigned. (Gargola-Chicago)
W69-02301

THE PLACE OF MULTIPURPOSE RESERVOIRS IN WATER SUPPLY PLANNING,
Public Health Service, Washington, DC.
Robert W. Haywood, Jr.
Journal of the American Water Works Assoc., Vol. 55, No. 3, March 1963, pp 263-266, 1 ref.

Descriptors: Multi-purpose planning, Water supply, Legislation, Municipal supply, Future planning, *Storage, Recreation, Industrial demand, Forecasting, *Repayment contracts.
Identifiers: Water Supply Act of 1958, Multi-purpose reservoirs, Revenue requirements.

A particularly important source of assistance for providing future water supply is the Water Supply Act of 1958. This Act makes possible storage in multipurpose reservoirs for anticipated municipal and industrial water demands. Although the advantages of this Act are many, certain errors should be avoided when planning the construction of multipurpose reservoirs with a substantial storage space for future demands. Too often there has not been recognition of the need for repayment of the costs to storage with a proportionate share of the cost of operating and maintaining such facilities. Overestimation of future recreation, municipal, and industrial water demand causes error. Careful and accurate study must be made to predict future needs and demands, so that they coincide to a reasonable degree, and revenue requirements are fulfilled. Care must be exercised on taking advantage of opportunities provided by the Water Supply Act so that too much or too little storage is not bought. Errors in either direction can be quite costly. (Gargola-Chicago)
W69-02308

EVALUATION OF INVESTMENTS IN WATER RESOURCE MANAGEMENT,
Wisconsin Univ, Madison, Wisconsin. Water Resources Center.
Irving K. Fox.
Journal of the American Water Works Assoc., Vol. 59, No. 8, August 1967, pp 913-918.

Descriptors: *Investment, Economic evaluation, Intangible benefits, Political aspects, Water resource development, Repayment contracts, Motivation, Project planning, *Water management, *Administrative decisions, Water policy, *Social values.
Identifiers: Range of choice, Flood Control Act, Cost sharing policies, Redistribution of income.

There are three fundamental limitations for any effort at technical evaluation of public investments: (1) intangible benefits and costs, (2) evaluation of redistribution of income, and (3) biased evaluations, reflecting different standards. There is considerable evidence to indicate that sight has been lost of the role of technical evaluation. The purpose of technical analysis is to serve the political process as effectively as possible. The public should make decisions regarding value judgments in water resource development. For this reason, all alternatives should be presented to them. There are difficulties, however in doing this: (1) presentation of the range of choice in a form easily understood by laymen is difficult, (2) individual agencies do not have the expertise, the authority, or the tradition to consider the full range of alternatives, (3) existing repayment of policies discourage the consideration of alternatives, and (4) public agencies, for reasons discussed, have a motivation not to present the range of choice. To aid in the solution of these problems four suggestions are presented: (1) experimentation and study should be undertaken by both planning agencies and research institutions to develop techniques for presenting the range of choice, (2) in training of engineers and economists the responsibility of a planner in a democratic society should be made clear, (3) patterns of organization and policy should be reexamined to determine necessary changes, and (4) a way should be developed for creating pressures on planning and administrative agencies which reflect the interests of all the concerned parties. (Gargola-Chicago)
W69-02311

SOME ECONOMIC ASPECTS OF WATER-QUALITY ENHANCEMENT,
Baltelle Memorial Institute, Columbus, Ohio.
Henry R. Hamilton.
American Institute of Chemical Engineers, St. Louis, Mo. Feb. 18-21, 1968, pp 23, fig 1.

Descriptors: Water pollution, *Water quality, Economic justification, Economic efficiency, *Economic evaluation, *Cost-benefit analysis, *Resource allocation, Mathematical models, Aesthetics, *Environmental effects.

The author analyzes the theoretical basis for evaluating water quality enhancement. The benefits he considers to be primarily recreational and aesthetic. Although he defines them as intangibles; he recognizes that recreation benefits can be evaluated, and he considers that aesthetics of water quality, when reflected in value of home sites and industrial areas, could be evaluated by 'common sense plus economic analysis'. For actual evaluation he suggests a model with population sector, economic activity sector, and water sector, including 'feedback' relationships. He concludes that despite billions of dollars to be spent to enhance water quality, little attempt has been made to come to grips with measuring the benefits to be derived. Perhaps our allocations of resources would be different if we evaluated water quality benefits. (Whipple-Rutgers)
W69-02399

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER POLLUTION -- 1968, PART 1.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02063

MUNICIPAL SEWER SERVICE CHARGES.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02064

MODERN SEWER-SERVICE CHARGES, PART I - WHY CITIES NEED THEM.
For primary bibliographic entry see Field 05D.
For abstract, see .

W69-02065

MODERN SEWER-SERVICE CHARGES, PART II - SOME TYPICAL RATES.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02066

WATER POLLUTION -- 1968 PART I -- (MODERN SEWER-SERVICE CHARGES, PART 3, METERED VS FLAT).
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02067

WATER POLLUTION -- 1968, PART 1 -- (MODERN SEWER-SERVICE CHARGES, PART 4, THAT ELUSIVE PERCENTAGE).
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02068

WATER POLLUTION -- 1968, PART I -- (MODERN SEWER-SERVICE CHARGES, PART 5, PENALTIES HURT YOUR UTILITIES).
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02069

SPECIAL CONSIDERATIONS IN DESIGN OF WATER RATES,
Brown and Caldwell, San Marino, California.
John C. Luther.
Journal of the American Water Works Assoc., Vol 55, No 3, March 1963, pp 325-335, 3 tab, 2 ref.

Descriptors: Public utilities, Municipal supply, Revenue, Pricing, *Adoption of practice, Administration, Operating costs, Depreciation, Investment, Schedules, *Water rates, Demand, Costs.
Identifiers: *Water rate design, Base year, Block rates, Zone rates, Demand rates.

Publicly owned utilities normally include their cost of participation in extensions as part of revenue requirements. For investor-owned utilities, the effect in revenue requirements is reflected in depreciation expense, income taxes, and return on investment. Depreciation expense as revenue requirement also has a different significance depending on ownership. Before any study is made of future revenue requirements, it is essential to examine current costs and revenues for the establishment of a base year from which projections can be made. Steps through which this can be carried out are discussed. Operating ratios for public and investor-owned utilities are compared. Similarity in revenue and operating expenses for both cases is recognized and suggestions for attaining uniformity in accounting practices put forth. Application of principles of pricing for determining proper rates to produce desired income is examined. Typical rate schedules, block rates, zone rates, and demand rates are considered for establishment of proper practices. The separation of commodity costs into pure commodity costs and demand costs is discussed. General price theory has only a limited application in design of water rates. Fundamental pricing concepts should be followed in establishment of blocks and ranges of rates. (Gargola-Chicago)
W69-02304

REVIEW OF RATEMAKING THEORIES,
Alvord, Burdick, and Howson, Chicago, Illinois.
Louis R. Howson.
Journal of the American Water Works Assoc., Vol. 58, No. 7, July 1966, p 849-855.

Descriptors: Water supply, Water consumption, *Water rates, Standards, *Water management, Operating costs, Financing, Long-range planning, Capital, Maintenance costs.
Identifiers: Revenue, *Ratemaking, Rate schedules.

Ratemaking should be preceded by long-range planning and study of present and future water requirements coordinated with a sound program of construction, financial planning for capital and its fixed charges, and operating and maintenance expenditures. Gross revenue requirements over the near future period, during which the rates will be collected must be carefully estimated and used in the allocation among consumers. The prime requisite of ratemaking is that the total revenue requirements be equitably apportioned between all classes of consumers. Rate schedules should have few steps and be based on the same principles for sale inside or outside the core city. U. S. practice, which requires the users to build and pay for water facilities by rates has produced the best water supplies in the world that make more and better water available to all classes. (Gargola-Chicago)
W69-02307

THE PLACE OF MULTIPURPOSE RESERVOIRS IN WATER SUPPLY PLANNING,
Public Health Service, Washington, DC.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-02308

NATIONAL PLAN TO SUPPLY DRINKING WATER TO URBAN DISTRICTS, 1966-1970. (SPANISH).
For primary bibliographic entry see Field 03D.
For abstract, see .
W69-02366

6D. Water Demand

SUMMARY REPORT ON THE RESIDENTIAL WATER USE RESEARCH PROJECT,
Johns Hopkins Univ., Baltimore, Md., Department of Environmental Engineering Science.
For primary bibliographic entry see Field 05F.
For abstract, see .
W69-02302

METHOD FOR ESTIMATING FUTURE DISTRIBUTION SYSTEM DEMAND,
John A. Strand and Assocs. Inc., Madison, Wisconsin.
John A. Strand.
Journal of the American Water Works Assoc., Vol. 58, No. 5, May 1966, pp 521-526.

Descriptors: Methodology, *Water demand, Storage capacity, Pumped storage, Water distribution, Long-term planning, Adoption of practices, *Forecasting, Estimating, *Decision making.
Identifiers: Distribution system demand, Meters.

A method is outlined for estimating future maximum water demands of a city along with a method of determining capacities needed to meet those demands. The method of estimating future demand is based on the premise that, except for large industrial demands, the future demands on a maximum day, and the distribution of the demands on that day, can be most accurately determined by extending past experience data. Each component of future demand is estimated by several methods, a figure is set for each component, and the total demand established by adding the components. Study of each component separately permits detection of any change in the rate of growth of that portion of the total demand. Use of several methods to estimate each component permits the use of averages that minimize the effect of unusual past performance, errors in the data, and human inaccuracies. Estimating capacity is discussed, considering the significant factors of pump and storage requirements. (Gargola-Chicago)
W69-02306

RELATIONSHIP OF DOMESTIC WATER USE TO ASSESSED VALUATION WITH SELECTED DEMOGRAPHIC AND SOCIO-ECONOMIC VARIABLES,
Illinois Univ., Urbana, Illinois. Department of Hygiene and Public Health and State Water Section, Urbana, Illinois.
Dorothy F. Dunn, and Thurston E. Larson.
Journal of the American Water Works Assoc., Vol. 55, No. 4, April 1963, pp 441-451, 2 fig, 3 tab, 18 ref.

Descriptors: *Methodology, *Water use, Water users, *Consumption, Social aspects, Behavior, Attitudes, Municipal water suppyl assessments, Parameters.
Identifiers: Kankakee (Illinois), Demographic variables, Socio-economic variables.

Literature on domestic water use includes only a few of the many variables which have some influence on domestic water demand. A review of past studies is given, indicating the emphasis of particular studies. In this report there were two aims in analyzing the factors which may cause variation in water use: (1) to learn the extent of uniformity in water use and (2) to learn of differences in water use by special group classifications. The method of procedure is outlined and general background information given. Simple correlations with socio-economic characteristics showed the maximum month household water use correlated best with occupation of principal wage earner. The second most important parameter was number in the household. These results suggest demographic and economic variables that may influence the water use patterns of households. This was a study of single dwelling units, in a particular city, Kankakee, and the findings may be similar but not specific, to other areas. (Gargola-Chicago)
W69-02309

AUSTRALIAN AND AMERICAN WATER ALLOCATION SYSTEMS COMPARED,
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02329

WATER-OUR SECOND MOST IMPORTANT NATURAL RESOURCE,
Rensselaer Polytechnic Institute.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-02332

IRRIGATION IN KANSAS.
Kansas Water Resources Board, Topeka.

Kans Water Resources Board Rep No 16 (e), 23 p, Sept 1967. 31 fig, 104 map, 34 ref.

Descriptors: *Data collections, *Irrigation water, *Kansas, Irrigation efficiency, Water development, Irrigation practices, Water yield, Water wells, Water demand, Water quality, Water levels, Surface waters, Groundwater, Planning.
Identifiers: *Potential irrigation development, Irrigators.

Data on irrigation in Kansas, including the amounts of surface water and groundwater used, well yields, water quality, saturated thickness of unconsolidated deposits, the amount of land suitable for irrigation, projected irrigation requirements, groundwater availability, and surface water availability, are summarized for each county. Because of profitability, irrigation is expected to increase in Kansas. At present withdrawal rates, there is a large groundwater overdraft. Water conservation measures are necessary and are being developed and put into use. These include evaporation control, more careful application of water, and studies of artificial recharge methods. Surface water availability is seasonal and erratic from year to year. To use it efficiently, much more surface storage or aquifer recharge must be developed. (Knapp-USGS)
W69-02348

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A SAMPLE DESIGN FOR INVESTIGATING THE EFFECTS OF STREAM POLLUTION ON WATER BASED RECREATION EXPENDITURES,
Pennsylvania State Univ., Institute for Research on Land and Water Resources.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-02357

MANAGEMENT: A KEY TO IRRIGATION EFFICIENCY,
Water Conservation Laboratory, Phoenix, Arizona.
Leonard J. Erie.
J. Irrig and Drain Div ASCE, Vol 94, No IR3, Proc Paper No 6107 pp 285-293, September 1968. 9 p, 2 fig, 4 tab.

Descriptors: *Irrigation efficiency, *Water loss, Planting management, Irrigation practices, *Water conservation, Water management (Applied), Water delivery, *Consumptive use, Arid climates, Surface waters, Seepage, Sprinkler irrigation, Farm management, Application methods, *Water conveyance.
Identifiers: *Irrigation agriculture.

Irrigated agriculture accounts for most of the water consumptively used. This is particularly true in the arid southwest. Losses of irrigation water that occur in its movement from source to ultimate use are described, and some unavoidable water losses in water management are identified. Various cultural practices, irrigation systems and consumptive use data were discussed in relation to water conservation. (Affleck-Ariz)
W69-02386

COMPETITION FOR RECREATION WATER IN CALIFORNIA,
Amalio Gomez, and Dale A. Crane.
J. Irrig and Drain Div, ASCE. Vol 94, No IR3, Proc. Paper 6109. pp 295-307, September 1968. 13 p, 2 fig, 3 tab.

Descriptors: *Recreation demand, Reservoirs, Water storage, Water loss, Water requirements, Arid climates, *Competition, *Multiple purpose reservoirs, California, Recreation facilities, Water resources development, Costs.

Water-oriented recreation has experienced tremendous growth in recent years. This has brought about great demand for minimum recreation pools and adequate recreation facilities at reservoir projects. Water pools for recreation require acquisition of water to fill them initially and to compensate for added evaporation losses later. This difficult problem was satisfactorily solved in four federal reservoirs in a water-deficient area in California. Procedure used entailed a high degree of cooperation by water users, public at large, and construction agency. Required water for recreation was estimated at less than one half of one percent of natural river flows. Total cost, including storage, water, recreation facilities, and maintenance and operation was estimated at $0.30 per recreation day. (Affleck-Ariz)
W69-02388

6E. Water Law and Institutions

KISTLER V WATSON (IMPROPER RESTRICTION OF STREAM FLOW).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02001

MONTELIOUS V ELSEA (WITHDRAWAL FOR IRRIGATION).
161 N E 2d 675-680 (C C Pl Ohio 1959).

Descriptors: *Ohio, Civil law, Judicial decisions, *Riparian rights, Competing uses, Natural use, *Reasonable use, Riparian waters, *Irrigation, Flow Diversion, Relative rights, Withdrawal.

Plaintiff and defendant owned contiguous tracts of farmland. Defendant was an upper riparian owner, and plaintiff was a lower riparian owner on a creek that both used to water livestock. Defendant occasionally used a pump to divert some waters from the creek to his farmland for irrigation purposes. Plaintiff sought an injunction to prevent defendant from thus diverting the waters. The court denied the request, holding that such use by defendant was not unreasonable. A riparian owner has a right to make reasonable use of a stream for the purpose of irrigation, such reasonableness to be determined on an individual basis and depending upon the particular circumstances involved. In this instance, at the times the defendant used his irrigation pump, the creek did not dry up nor was the plaintiff deprived of the water needed for his livestock. The right of a riparian owner to make reasonable use of a stream for the purpose of irrigation is a property right and is entitled to protection. (Scott-Fla)
W69-02003

BEHRENS V SCHARRINGHAUSEN (REASONABLE USE OF PERCOLATING WATERS).
22 111 App 2d 326, 161 N E 2d 44-46 (1959).

Descriptors: *Illinois, Judicial decisions, Pumping, Drainage systems, *Percolating water, Percolation, Subsurface runoff, Diffusion, *Reasonable use, Water table, Water supply, Wells, *Subsurface waters.

Plaintiffs owned a farm, for which they obtained water from sources beneath and upon their lands. Defendants operate a sand and gravel pit adjacent to plaintiff's farm. Subsurface waters started to seep into the defendant's gravel pit in 1956, and defendants installed two pumps to remove it. The excess water is pumped to the surface and discharged into a stream that flows through the plaintiffs' lands. Plaintiffs claimed that the use of the pumps lowered the water table, forcing them to sink deeper wells and use larger pumps to obtain the amounts of water their farm required, and asked that the court grant a permanent injunction to restrain defendants' from continuing the pumping. The court held that defendants had not irreparably injured the plaintiffs, and denied the injunction. The court also discussed the two basic rules of law governing 'percolating water' disputes. The English rule permitted a landowner to dig below the surface of his land and apply all that is found there to his own purposes, without any restrictions. This has been rejected in many areas in favor of what is generally known as the American doctrine of 'reasonable use', which limits the right of the landowner to such amount of the percolating waters under his lands as may be necessary for some useful purpose. The latter doctrine would probably be followed by this court (Illinois). (Scott-Fla)
W69-02004

CUTLIFF V DENSMORE (OWNERSHIP OF ACCRETED LAND).
354 Mich 586, 93 N W 2d 307-311 (1958).

Descriptors: *Michigan, Civil law, Judicial decisions, *Accretion (Legal aspects), *Boundaries (Property), *Boundary disputes, Shores, Lake shores, Navigable waters, Riparian waters, Meanders.

Four lots on a bay abutted each other in the shape of a block letter 'L' with lot one at the top, lot two below, lot three at the base, and lot four forming the horizontal portion of the 'L'. Each lot had some varying portion of the shoreline as one of its boundary lines. Since the original plat was made land formed by accretion between the present shoreline and lots three and four, with some amount of recession to lots one and two. The shoreline then ran almost diagonally from the northern tip of the 'L' straight to the eastern-most end of the base of the 'L'. A boundary dispute arose over ownership of the accretion land between the owners of lots three and four. The court held that where property abuts a shoreline, that shoreline as represented on government plats by a meander line is the boundary of the property notwithstanding its subsequent advancement or recession. The court affirmed the decision of the lower court which held that the present shoreline and accreted land should be divided between the four lots in the same proportion that each lot bore to the original shoreline as shown by the meander line on the original government plat. (Scott-Fla)
W69-02005

WILCOX V PINNEY (TITLE TO ACCRETION).
98 N W 2d 720-726 (Iowa 1959).

Descriptors: *Iowa, Judicial decisions, Ownership of beds, Riparian land, *Boundaries (Property), Avulsion, Bank erosion, Navigable rivers, *Accretion (Legal aspects), Erosion, High water mark.

In this suit to quiet title, plaintiff claimed absolute and unqualified legal ownership of a certain real property. The record title to this property has been in plaintiff and his predecessors for over one hundred years. At the time of the original government plat in about 1850 a river hugged the western side of the tract in question. This river moved east about seventy five years later, and about ten years after this returned to its former and present position. The court found that in making these changes, the river slowly eroded away all the intervening land, and then by accretion rebuilt it. At one time during the erosion little or none of the land in question was above the high water mark. Plaintiff's claim of title was erased, because the eroded land was no longer subject to identification; in such cases, the title to the land so occupied by the bed of the river passes from the owner of the land to the state. The court held that the counter-claimants had title to the land by virtue of their ownership of the land along the east high bank of the river, to which the accreted land attached. (Scott-Fla)
W69-02006

WISE MANAGEMENT OF NORTH CAROLINA WATER RESOURCES THROUGH LAW (AN ORIENTATION BROCHURE).
North Carolina Dept of Water Resources, Orientation Brochure Vol 1, Aug 1966, 114 pp.

Descriptors: *North Carolina, *Administration, *Water resources development, Regulation, State governments, Competing uses, Research and development, Political aspects, Legislation, *Water conservation, Groundwater, Surface water, Administrative agencies.
Identifiers: *Quantity control.

This study was authorized by the 1965 North Carolina General Assembly. Its aim was to solicit a response to the Board of Water Resources' request for advice from all sources in regarding methods and policies for safeguarding and developing the state's water resources. Problems of water quantity were the major concern of the study. The Board was convinced that its existing powers were inadequate to meet the problems facing it. Chapter 1 outlines the history of water resources research in N C and gives the current status of programs and agencies concerned with water resources. Chapter 2 discusses surface water problems, ground water problems and their interrelationship. The specific problem which prompted the Board to seek additional powers, which revolved around a proposal to lease two river bottoms to phosphate mining companies, is discussed. This chapter attempts to set out the reasons why N C has a need for additional regulation of water resources. Chapter 3 explores legislative developments in other states with regard to water quantity control. Chapter 4 sets out possible courses of action and concludes that some significant regulatory legislation is needed. A list of 33 references is included. (Williams-Fla)
W69-02007

RELATIVE RIPARIAN OR LITTORAL RIGHTS RESPECTING THE REMOVAL OF WATER FROM A NATURAL, PRIVATE, NON-NAVIGABLE LAKE,
C. C. Marvel.
54 ALR 2d 1450-1454.

Descriptors: Riparian rights, Riparian land, Judicial decisions, Ownership of beds, *Reasonable use, *Lakes, *Natural flow doctrine, Competing uses, Legal aspects, Water law, *Relative rights, Water utilization, Non-navigable waters, Ponds, Water levels, Irrigation.

Conflicts between riparian owners having equal legal rights by virtue or their riparian ownership alone are discussed. Specifically the right of one owner to remove water from a private, non-navigable, natural lake or pond is balanced against the right of another owner to have the level of the water maintained. The key terms used are defined and explained. There are two general theories concerning riparian rights applicable to the narrow factual situation posed by this annotation, the natural flow and the reasonable use theories. Under the natural flow theory, a riparian owner using the water is presumed to have the right to use the water as long as such use does not unreasonably interfere with the use of another owner. Cases are discussed to illustrate the extent to which the application of the different theories make a practical difference in the result. (Smith-Fla)
W69-02008

APPORTIONMENT OF AREA OF RIVER BETWEEN RIPARIAN TRACTS FRONTING ON SAME BANK,
C. T. Foster.
65 ALR 2d 143-194 52 p, 27 ref.

Descriptors: Adoption of practices, *Distribution patterns, Water distribution (Applied), Boundaries (Property), *Boundary disputes, Civil law, *Equitable apportionment, Judicial decisions, Legal aspects, Legislation, Ownership of beds, Relative rights, Riparian land, *Riparian rights, Riparian water, Water law, Rivers, Local governments, State governments.

An annotation is presented of the law in various states covering the question: In the absence of agreement or controlling specifications, how will the area of a river or river bed be apportioned between two or more tracts of riparian land lying along the same side of the river. The annotation is concerned with methods of projecting boundary side lines out from the bank of the river. It is concluded that the most generally recognized over-all rule is that courts should give riparian rights to the river on the basis of the proportionate extent of river frontage. The effect of provisions of local statutes is discussed briefly. Specific rules, methods and determinations are analyzed in detail. Emphasis is given to the interpretation of these formulations in various states. Among the methods discussed are perpendicular projection methods using the thread of the stream, the course of the river, the line of the channel, or the line of the shore as a basis. Projection in the direction of the channel, and special problems involved with curved channels or shorelines are also discussed. (Pfeiffer-Fla)
W69-02009

WATER RIGHTS, NAVIGABLE STREAMS, ETC.
85 Ga Code Ann secs 85-1301 to 85-1312 (1967).

Descriptors: *Georgia, Legislation, Navigation, *Ownership of beds, *Riparian rights, Navigable waters, Non-navigable waters, Streambeds, Boundaries (Property), Dams, Ditches, *Tidal water, Water law, Watercourses (Legal), Riparian land, Dam sites.

Running water belongs to the owner of the land over which it runs, but he may not interfere with its enjoyment by the next owner. Beds of non-navigable streams belong to the owner of the adjacent land; but if they are dividing lines, each owner owns to the thread of the stream. Provision is made for stream changes. Gradual accretions to land accrue to the owner. A definition of a navigable stream is given. Riparian owners' rights extend to the low-water mark. An owner of a non-navigable stream may do with it as he pleases, except for creating nuisance. Dams for water power may be constructed by owners on land on the opposite side of a non-navigable stream, provided they pay damages for injury to private property. Title to the beds of non-navigable tidewaters is in the adjacent landowner. Provisions are made for waters forming boundaries. A definition of navigable tidewater is given. Title of owners adjacent to navigable tidewaters extends to the low-water mark. Owners of land adjacent to watercourses are empowered to ditch and embank their lands to avoid damage from overflows. Provisions are made for the establishment of bridges and ferries. No franchise granted by the state is to be exclusive unless expressly so stated. (Williams-Fla)
W69-02010

LIABILITY FOR INJURY TO PROPERTY OCCASIONED BY OIL, WATER, OR THE LIKE FLOWING FROM WELL,
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-02011

POWERS AND DUTIES OF CITIES AND TOWNS--POWERS AND PROCEDURE FOR A TOWN TO ESTABLISH A WATER SUPPLY SYSTEM.
Mass Ann Laws, ch 40, secs 38-42 1 (1966).

Descriptors: *Massachusetts, Legislation, *Water supply, Water sources, Water control, Local governments, *Water works, Utilities, Water distribution (Applied), Water shortage, Human population, *Water management (Applied), Eminent domain, Fluoridation, Assessments, Taxes, Payment, Prices, Water rates, Administrative agencies.

Section 38 empowers a city or town, after approval of two-thirds of its governing council and a majority of its voters, to purchase water or water rights for the purpose of supplying water to itself and its inhabitants. A specific procedure is outlined in Section 39 and its subsections. A town can purchase and transport water from another town or it can establish its own water works, by taking land by eminent domain, constructing dams, reservoirs, etc., and electing a board of water commissioners to manage, improve, and control the waterworks. Subsection 39F enables inhabitants to recover damages incurred by the establishment of the water works, and subsection 39G provided penalties for any willful interference with the water system. Sections 40 and 41 enumerate various powers of the towns in connection with water supply, including the right to draw water from any stream, pond, reservoir or other ground source in case of emergency, taking property within the watersheds of water supply sources to protect and preserve the purity of the water, and restricting the inhabitants water use in case of emergency. Subsections 41 B and C give the voters control over fluoridation of the water supply. Subsections 42 A-F set out various procedures for collecting unpaid water charges. Subsections 42 G-I give the towns the power to assess property owners at a fixed uniform rate for the cost of laying pipes for water distribution. (Sisserson-Fla)
W69-02012

DEPARTMENT OF WATER AND AIR RESOURCES OF NORTH CAROLINA.
21 N C Gen Stat sec 143-211 to 215 (1967).

Descriptors: *North Carolina, Legislation, Beneficial use, Water utilization efficiency, Public health, Water pollution, *Pollution abatement, *Water pollution control, *Administrative agencies, Coordination, State governments, Federal government, Water allocation (Policy), Jurisdiction, Water management (Applied), Interstate, Water conservation.

An agency to administer a program of water pollution control and water resource management is created. The Board's organization is set out with specificity including apportionment of membership, compensation, and appointment of a director. It is declared that the legislature's intent is that the board cooperate with other states and with the federal government. The Board is directed to survey all of the state's waters, and to develop and adopt classifications and standards for all of the state's waters. Permissive criteria for assignment of classifications are set out. Permits are required from the Board in order for individuals to engage in activities which may provide new sources of water pollution. The Board is empowered to engage in activities for the abatement of present pollution sources as well. Judicial review of the Board's decisions is provided, and penalties for violations of orders are set out. The Board is further empowered to designate areas where water use requires regulation. (Pfeiffer-Fla)
W69-02013

FRAUDULENT DIVERSION OR USE OF WATER.
Ala Code, tit 48, sec 411 (1958).

Descriptors: *Alabama, *Legislation, Reservoirs, Aqueducts, Pipes, Cities, *Diversion, Consumptive use, *Municipal water, Measurement, Instrumentation, Water measurement.

It is a misdemeanor punishable by a maximum fine of $50 or imprisonment of 30 days to divert the water from any pipe, aqueduct, reservoir, main, or pipe of another person, water company, or any municipality authorized to supply water for public use. The diversion must be done with intent to defraud. Any person diverting water around a water meter or altering a meter so that it doesn't register is likewise guilty of the same misdemeanor. (Watson-Fla)
W69-02014

CESSION OF SITES COVERED BY NAVIGABLE WATERS.
Ala Code, Tit 59, sec 3 (1958).

Descriptors: *Alabama, *Legislation, *United States, Federal government, Navigable waters, Ownership of beds, *Lighthouses, Jurisdiction, Federal jurisdiction, State jurisdiction.
Identifiers: Beacons.

Authority is given to the governor of Alabama to convey title to state lands covered by navigable waters to the United States for the site of a lighthouse, beacon, or other aid to navigation. Proper application must be made by an authorized agent of the United States describing the site required for one of the purposes mentioned above. No single tract may contain more than 10 acres. The governor may also cede to United States such jurisdiction over the tract as is required. (Watson-Fla)
W69-02015

IOWA'S NEW WATER STATUTE - THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER,
Jeffrey O'Connell.
Iowa L Rev, Vol 47, No 3, pp 549-636, Spring 1962. 88 p, 528 ref.

Descriptors: Legislation, *Iowa, Competing uses, Riparian rights, *Water allocation (Policy), Administration, *Administrative agencies, *Water permits, Surface water, Groundwater, Water policy, Relative rights, Legal aspects.
Identifiers: Quantity control, Constitutional law.

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Iowa established a permit system of water allocation in 1957, which is administered by a Water Commissioner. The statute applies to both existing and unused water rights and to both surface and groundwater. Permits are for 10 years and require beneficial use. The legislative history of the act, along with Iowa's water resources and demands are discussed. Household uses are exempted from the act, as are uses under 5,000 gallons per day, existing uses within municipalities and use of water of border rivers. Other provisions are discussed. The hydrologic cycle is explained. Iowa water law before passage of the statute is outlined. The law's ignorance of the hydrologic cycle and reliance on courts to enforce water rights is pointed out. Existing water rights are property and are protected by both the state and federal constitutions. The arguments for and against the conclusion that the statute unconstitutionally impairs riparian rights are given. Cases on water statutes are discussed. The distinction between existing and unused rights is explained, and it is suggested that the term 'vested rights' in the statute be interpreted to mean 'used rights'. This would help its chances of being held constitutional. Limitations on riparian rights are discussed. The actual changes brought about by the Iowa statute are carefully detailed. It is concluded that the act should not be held unconstitutional for regulating existing uses. (Williams-Fla)
W69-02016

JOINT WATER SUPPLY FACILITIES.

N C Gen Stat sec 160-191.6--160-191.10 (1964).

Descriptors: *North Carolina, *Legislation, Streams, *Cities, Dams, Reservoirs, *Water supply, Reservoir storage, Financing, Intakes, Conduits, Pipes.
Identifiers: Bonds.

Any two or more municipalities in the State of North Carolina are authorized to acquire lands and water rights along any stream, to the extent they deem necessary or convenient, for the construction of a dam and reservoir to provide water to the municipalities. The municipalities are also empowered to maintain and improve the dam and reservoir facilities. The dam and reservoir facilities do not have to be within the corporate limits of the municipalities, and the municipalities are authorized to construct all intakes, mains, and all other facilities necessary to transport the water to them. The municipalities may enter into any agreements or contracts among themselves or with other parties pertaining to dividing water from the facilities, or to construct or maintain the dam and other facilities. The municipalities are also authorized to issue all bonds necessary to finance the acquisition, construction, or improvement of these water supply facilities. (Watson-Fla)
W69-02017

BURCH V MACKIE (SURFACE RUNOFF).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02018

OBRECHT V NATIONAL GYPSUM CO (RIPARIAN RIGHTS IN GREAT LAKES).

361 Mich 399, 105 NW 2d 143 (1960).

Descriptors: Judicial decisions, *Michigan, *Great Lakes, Lake Huron, *Riparian rights, Beds, *Ownership of beds, Wharfs, Administrative agencies, State jurisdiction, Abatement.

Plaintiff homeowners on Lake Huron brought suit against the defendant riparian owner, which was building a large loading dock, and against the Michigan Department of Conservation to obtain a decree that an act authorizing such Department to convey to the defendant certain lake bottom lands was unconstitutional. Generally, the beds of the Great Lakes are inalienable and the public title and right of Michigan in Lake Huron's bed is supreme against a riparian owner's right to wharf out. The legislature or its authorized agency must approve before any deep-water dock can be constructed. Since the area where this dock was constructed was substantially devoted to vacationing or living in the wooded sector of the shore, the defendant's act of constructing a dock in the locality constituted an actionable nuisance. Because the dock construction is completed, it would be an even greater wrong to force its removal, but plaintiffs can recover damages. (Williams-Fla)
W69-02019

CERNAK V KAY-VEE REALTY (LIABILITY FOR SURFACE DRAINAGE DISCHARGE).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02020

SULLIVAN V BOARD OF COMMISSIONERS OF LORAIN COUNTY (INCREASED SURFACE DRAINAGE FROM UPPER LAND).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02021

VILLAGE OF CHESTER V KANTOD PARK ASSOC, INC (WITHDRAWAL OF WATER FROM LAKE).
13 A D 2d 709, 214 N Y S 2d 194-196 (App Div 1961).

Descriptors: *New York, Judicial decisions, Competing uses, Legal aspects, Water rights, *Withdrawal, Lakes, Cities.
Identifiers: *Pleadings.

Plaintiff village sought an injunction to stop defendant corporation from withdrawing water from a lake to which the village claimed exclusive water rights. Defendant alleged as affirmative defenses that plaintiff came into court with unclean hands and that plaintiff suffered no damage by reason of defendant's withdrawal of water. The court held that since the defendant did not present any facts to support his pleadings, the defenses were insufficient. (Sisserson-Fla)
W69-02022

LOUISVILLE AND NASHVILLE R R V BUSH (DRAINAGE OF SURFACE WATER).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02023

WYATT V WYCOUGH (ACCRETION).

341 SW 2d 18-22 (Ark 1960).

Descriptors: *Avulsion, *Arkansas, *Boundaries (Property), *Accretion (Legal aspects), Judicial decisions, Remedies, Adjudication procedure.
Identifiers: Adverse possession, Ejection.

In an action for ejectment defendant claimed, among other things, that he had gained title by accretion. The court defined accretion as the increase of real estate by the addition of portions of soil by gradual deposition through the operation of natural causes. Avulsion is a sudden gain or loss of riparian land caused by the sudden abandonment by a stream of its old channel and the creation of a new one, or the sudden washing from one of its banks a considerable body of land and the depositing of it on the opposite bank. When a stream shifts suddenly by avulsion the boundaries of the riparian owners do not change with the course of the stream. In the present case evidence showed that an avulsion occurred and title to the land did not pass. (Kahle-Fla)
W69-02024

AN ACT... TO SPECIFY THE POWERS OF TH DEPARTMENT OF WATER RESOURCES ESTIMATING WATER STORAGE NEEDS AND TO AUTHORIZE CONTRACTS WIT FEDERAL AUTHORITIES FOR REPAYME OF WATER SUPPLY COSTS.

Maryland Laws Ch 671 (1967).

Descriptors: *Maryland, Legislation, Administ tive agencies, State governments, Water supp Reservoir storage, Streamflow, *Water quality c trol, *Cost repayment, Contract administration.

Section 53A added to Art 96A of the Annota Code of Maryland (1964 Replacement Volum entitled 'Water Resources', subtitled 'Other Pow and Functions,' specified certain powers of the partment of Water Resources. The Act empow the departmenthen the need arises in the state water supply storage or storage for stream-fl regulations for quality control, to estimate wa storage needs in federally constructed reservoir the state and to contract with federal authorities repayment of water supply costs. (Sisserson-Fla)
W69-02025

CITY OF BANGOR V PUBLIC UTILIT COMM'N (WATER ALLOCATION).
167 A 2d 6-17 (Me 1960).

Descriptors: Water allocation, Watercour Water control, Water rates, Water distri *Water delivery, Water measurement, *Wa supply, Water utilization, Public utilities, Admi trative agencies, Administrative decisions, Ci Judicial decisions, *Financing, *Maine.

Prior to the formation of the Bangor Water trict, water taken from the Penobscot River sufficient for fire fighting purposes of the cit Bangor. But with the advent of the new syst designed to carry water for fire protection as as for general consumptive use, use of river w was abandoned. The issue raised by the city of B gor, through exceptions to an order of the Pu Utilities Commission, was the proper allocatio the cost of the new system between fire protec and general use. After an extensive analysi methods of apportionment and the opposing v points of the city and the Public Utilities Com sion, the Supreme Court of Maine held that cost of the new system was properly alloc between fire protection and general users c capacity basis rather than on the basis of estim water use. (Carruthers-Fla)
W69-02026

MARINE BOUNDARIES OF THE COMM WEALTH.
Mass Ann Laws, Ch 1, Sec 3, 1966.

Descriptors: *Massachusetts, Boundaries (Pro ty), Low water mark, State jurisdiction, W rights.

The territorial limits of the commonwealth shal tend one marine league from its seashore a treme low water mark, and the exterior line o commonwealth as located and defined by Board of Harbor and Land Commissioners u chapter one hundred and ninety-six of the ac eighteen hundred and eighty-one shall be p facie the marine boundary of the commonweal an inlet or arm of the sea does not exceed marine leagues in width between its headlan straight line from one headland to the other sha equivalent to the shore line. (Horner-Fla)
W69-02028

MASSACHUSETTS COUNTY BOUNDARIE TERRITORIAL WATERS.
Mass Ann Laws, Ch 34, Sec 1 (1966).

Descriptors: *Massachusetts, *Boundaries perty), *Local government, *Tidal waters, Le

on, Cities, Jurisdiction, State governments, State jurisdiction.

This section establishes the marine boundary of the commonwealth as the boundary of counties bordering on the open sea. It establishes the boundary nes in tide water between coastal municipalities as ne boundary lines between the respective counties n which they are located. Counties separated by aters within the jurisdiction of the state shall exerise concurrent jurisdiction over such waters. A ase note to the section illustrates that the statute is ne of those which expressly provides for the inclu on of territorial waters within county limits. Smodish-Fla)
W69-02029

ANDS RESERVED TO THE STATE.
a Code Ann Secs 91-102 (1967).

escriptors: *Georgia, Legislation, *State governents, *State jurisdiction, Islands (Public lands).
dentifiers: State lands.

ecs 91-102 provides that the lands specially eserved to the state are: the lands known as the McIntosh Reserve,' on which Indian Spring is situted; a quantity of land on Flint River, opposite the ld Indian Agency; one mile square on the Chatahoochee River at McIntosh Ferry; five miles quare on the Chattahoochee River at Cusseta alls, including the falls; all islands contained in ny of the navigable waters of the state and not isposed of, and the western bank of the Chatahoochee River to the highwater mark, where it orms the boundary between Georgia and Alabama; the fractional parts of surveys created by ne different land divisions which are not granted therwise disposed of; and all lands omitted to be urveyed, granted or sold. (Williams-Fla)
W69-02035

ROBLEMS AND PROGRAMS IN WATER POLUTION,
or primary bibliographic entry see Field 05G.
or abstract, see .
W69-02036

EGULATION OF CANALS.
or primary bibliographic entry see Field 04A.
or abstract, see .
W69-02042

HIO WATER MANAGEMENT AND WATER OLLUTION CONTROL.

hio Laws Ch H 314 (1967).

escriptors: *Ohio, *Administration, *Water polution control, *Administrative agencies, Legislaion, Water resources development, Planning, oordination, State governments, Regulation, ewage disposal, Waste disposal, Treatment facilies, Standards, Water quality, Grants, Permits, Adinistrative decisions, Judicial decisions, Water ollution.
dentifiers: Water Pollution Control Act, State overnors.

he Act amends and enacts several sections of the evised Code. It provides for the appointment and omposition of the department of natural resources nd enumerates the powers of the director of natual resources. The Act creates and establishes the omposition of the Ohio water commission within he department of natural resources. It declares the urposes and powers of the commission. The Act lso establishes supervision over the treatment and isposal of industrial wastes by the department of ealth. The water pollution control board is stablished by the Act, which also provides for its omposition and specified its powers. Any pollution of the waters of the state is declared a public uisance, except where the water pollution control oard has issued a permit. A permit issued by the water pollution control board is required before disposing of any sewage or wastes in the waters of the state, except in specified situations. The water pollution control board is empowered to adopt water quality standards. The Act includes definitional sections and sections pertaining to adoption of rules and regulations, appeals from findings of the director of health, funding of projects, and coordination among agencies. (Smodish-Fla)
W69-02043

GEORGIA WATERWAYS COMMISSION.

Ga Code Ann Secs 17-301 -- 17-306 (1967).

Descriptors: *Georgia, Legislation, *Administrative agencies, *River basin development, Federal government, *Flood control, Rivers.
Identifiers: Water agencies.

The Georgia Waterways Commission is created, consisting of a chairman and one member from each of the five major river basins. Terms of office, vacancies and compensation are set forth. The Commission is directed to negotiate with the federal government regarding river development, particularly flood control. It has no power to make binding contracts or obligations. (Williams-Fla)
W69-02058

WATER SUPPLY QUALITY CONTROL.

Ga Code Ann Secs 88-2601 -- 88-2618 (1967).

Descriptors: *Georgia, Legislation, *Administrative agencies, Administration, *Water quality control, *Water supply, Standards, Water permits, Water utilization, Water resources, Water sources.
Identifiers: Water agencies.

Legislative policy is that the prudent use of water and its quality are major factors involving the health and welfare of the people of the state. The Board of Health is designated as the agency to administer the provisions of this act. The Board is to: establish water quality standards; establish standards relating to storage, distribution and treatment of water; conduct studies and research; issue certificates for the operation of community water systems; cooperate and enter agreements with other agencies; promulgate rules and regulations; and issue orders. Operation of any community water supply is unlawful without Board approval. The Board is granted access to any property for the purpose of making investigations. Information secured by the Board may not be used in a suit involving private rights, and certification is not a good defense to such suit. Appellate procedures, penalities, and emergency powers are adopted. The Director is authorized to bring actions for injunctions to abate public health hazards. (Williams-Fla)
W69-02060

MUNICIPAL WATER RIGHTS,
Edward F. Taylor.
Journal of the American Water Works Assoc, Vol 58, No. 7, July 1966, pp 856-865, 49 ref.

Descriptors: Water supply, *Water law, Legal aspects, Federal government, Legislation, Water rates, *Municipal water supply, State governments, Local governments, Federal jurisdiction, State jurisdiction, Regulation, *Water rights, Water contracts.
Identifiers: Municipal water rights, Discriminatory rates, Franchise fees.

The lack of a clear definition of national and local rights in water has contributed to the deterioration of federal-local regulations. The federal position is that the government owns rights to water under state law, without being subject to the same restrictions imposed by state legislatures upon nonfederal claimants. A bill before Congress (S. 1275) sets forth reasonable conditions for the acquisition and exercise of water rights by federal agencies, and does not abridge any constitutional power. The bill's principal provisions are reviewed and discussed. Such legislation will preserve the historic role of municipal corporations and the states in water resource development and will protect local water rights. A number of decisions, which support the general rule that a municipality may exercise reasonable and fair discretion in determining whether to make extensions of its lines are cited. As a general rule, water rates set by municipal officers charged with legal duty, will not be overruled without clear proof of unreasonable charges set in an arbitrary and illegal manner. The cases in which this principle is reaffirmed are noted and serve to further define municipal water rights. Other legal considerations in discriminatory rates, regulations, enforcement, collection and franchise fees are discussed and serve as an indication of the legal boundaries imposed on municipal water rights in relation to other governmental jurisdictions. (Gargola-Chicago)
W69-02300

FINANCIAL MANAGEMENT OF A WATER UTILITY,
City Water Board, San Antonio, Texas.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-02301

MANAGEMENT RESPONSIBILITIES AND OBJECTIVES IN INVESTOR-OWNED AND MUNICIPAL UTILITIES,
Northern Illinois Water Corp., Champaign, Illinois.
Edward R. Healy.
Journal of the American Water Works Ass, Vol. 58, No. 5, May 1966, pp 511-516.

Descriptors: *Water management, Administrative decisions, Investment, *Public utilities, Water rates, Local governments, *Political aspects, Pricing, Financing, Water quality, Project planning.
Identifiers: Water services, Return on investment.

Examined are the investor-owned and the municipally-owned utility for the purpose of evaluating management responsibility and objectives. The investor-owned utility is a business concern with the prime purpose of earning a profit. For this reason, it must sell its product, water, at a price to cover costs. In doing this, responsibility to the three major concerned groups, customers, stockholders, and employees, is met. The municipally-owned utility should have the same responsibilities, therefore, the same objectives, as an investor-owned utility. In certain cases this is recognized by the municipal administration, but difficulties stand in his path. The water utility operated as a department of the municipal government is too often used to further some political or social objective. Also, the real managerial decisions are often made by an elected or appointed commissioner, whose primary qualifications are political. Management responsibilities should be the same regardless of the type of ownership. The only practical way to accomplish this is by the complete removal of politics from the management of the utility. (Gargola-Chicago)
W69-02305

NEW MANAGEMENT TECHNIQUES,
Kaiser Aluminum and Chemical Corp., Oakland, California.
James R. Schultz.
Journal of the American Water Works Assoc., Vol. 59, No. 6, pp 675-679.

Descriptors: Motivation, Behavior, Attitudes, *Administrative decisions, Social participation, Social aspects, *Social adjustment, Human resources, *Employment opportunities.
Identifiers: T-group method, Pattern of inquiry, Psychological testing.

There is mounting evidence of critical deficiencies in systems of management; personality appraisals, boss subordinate counseling sessions, statistical

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measures of performance, communication devices, efficiency programs and other tools of management need reevaluation. A scientific approach to management is necessary, involving the asking and answering of the proper questions: How many jobs will be eliminated due to technology; How many jobs will be vacated or created because of turnover and growth; How will the net manpower requirements break down in terms of production, engineering, and marketing; and Where is the back strength weakest and strongest in terms of meeting long range needs. Motivation and assumptions about people are discussed, and the shifting basis of authority considered. The potential skilled manpower shortage is realized and suggestions made for seeking out alternative talent; search out talent beyond the immediate range of succession and let workers realize their potential within the organization. In implementing career plans, certain flexible guidelines should be observed: (1) a man should not be moved to a new position until he has mastered the old, (2) a new position should offer a full challenge, (3) developmental moves should be aimed to coincide with normal replacement requirements and (4) outside schooling should complement the experience and training offered on the job. Mutual establishment of goals and deadlines for current responsibilities by both management and salary has been shown to have the most significant effect on productivity. Management by fragmented programs and techniques is becoming obsolete, and objective planning constructed around a pattern of inquiry must replace it. (Gargola-Chicago)
W69-02310

ANALYSIS OF FEDERAL WATER POLLUTION CONTROL LEGISLATION, 1948-1966,
Cornell Univ., Ithaca, New York. Water Resources Center.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02312

WATER-QUALITY CONTROLS ENFORCEABLE IN COURTS UNDER STATE LAW,
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02314

POLLUTION AFFECTING RIPARIAN RIGHTS IN DEFINED CHANNELS OR DEPRESSIONS ON THE SURFACE OF THE GROUND,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3 Water Pollution and Quality Controls, 1967, pp 53-88.

Descriptors: *Riparian rights, Water pollution, *Reasonable use, Water quality, Watercourses (Legal), Lakes, *Invasion, Wastes, Sewage disposal, Streams, Dams, Backwater, Appropriation, Channels, Natural flow doctrine, *Social values, Damages, Water law.

A riparian right to the use of water from a watercourse or lake extends to the quality of that water as well as to its quantity. The rationale of liability for pollution rests on the natural-flow theory, which seeks to preserve the natural flow, and the full beneficial or reasonable use theory, which places emphasis on the greatest utilization of the water. For the defendant to be liable for an unintentional invasion there must be substantial harm and negligent, reckless, or ultrahazardous conduct. The defendant can be found liable for an intentional invasion if the plaintiff suffers substantial harm and the utility of the defendants conduct does not outweigh the gravity of the harm to the plaintiff. Comparisons must be made between the conflicting social values, but there is usually a preference for natural uses. Important factors in determining the reasonableness of pollution by defendant's riparian use are the practicability of defendant's preventing or avoiding the harm being caused by his use, and the burden on the plaintiff of avoiding the harm. There is a definite preference for riparian users and uses as opposed to nonriparian. (Watson-Fla)
W69-02315

POLLUTION AFFECTING APPROPRIATIVE RIGHTS IN DEFINED CHANNELS OR DEPRESSIONS ON THE SURFACE OF THE GROUND,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3 Water Pollution and Quality Controls, 1967, pp 89-107.

Descriptors: *Appropriation, *Riparian rights, *Water pollution, Water quality, Watercourses (Legal), Lakes, *Invasion, Channels, Damages, Water law.

The superior right of the prior appropriator is preferred over the junior right of a subsequent appropriator, whose right in turn is preferred over an appropriation subsequent to his. That preference has two results: (1) the subsequent appropriator is subject to liability for damages for polluting the water used by a prior appropriator; (2) the prior appropriator is not subject to liability for polluting the water used by a subsequent appropriator. The preference is limited in four ways: (1) the pollution must affect one of the purposes for which the prior appropriation was made; (2) the pollution must affect actual or contemplated uses within the scope of the prior appropriation; (3) the pollution must cause substantial harm to such uses; (4) under all the facts and circumstances of the case, the pollution or the harm must not be practicably avoidable or preventable by the prior appropriator -- assuming first that they are not practicably avoidable or preventable by the subsequent appropriator or other junior water user. If the invasion is unintentional the subsequent appropriator is liable only if there is substantial harm and his conduct is negligent, wreckless or ultrahazardous. (Watson-Fla)
W69-02316

POLLUTION OF WATER IN DEFINED CHANNELS OR DEPRESSIONS ON THE SURFACE OF THE GROUND UNDER COMBINED RIPARIAN-APPROPRIATIVE SYSTEMS,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp 107-113.

Descriptors: *Riparian rights, Appropriation, *Prior appropriation, Water rights, Beneficial use, *Preferences (Water rights), Priorities, Channels, Invasion, *Competing uses, Reasonable use, Water pollution.
Identifiers: Negligence.

The relationship between riparian and appropriative rights has given rise to two types of problems. First, in jurisdictions that recognize both riparian and appropriative rights pollution from the use of water under one type of right may interfere with the use of water under the other type of right. In general, one right will be prior to the other, and in most instances the riparian rights are preferred over the appropriative. Second, some jurisdictions apply or attempt to apply the law of riparian rights to cases involving appropriative rights. In strict logic, under the appropriation system the rule governing equal but correlative riparian rights could be applied only where the appropriations are of equal priority. (Watson-Fla)
W69-02317

POLLUTION OF WATERS UNDER THE SURFACE OF THE GROUND,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp 114-122.

Descriptors: Riparian rights, Appropriation, Invasion, Prior appropriation, Water rights, Priorities, Channels, Prior appropriation (Water rights), Competing uses, Reasonable use, *Water pollution, Subsurface waters, *Percolating water, *Underground streams, *Underflow.

Underground waters are classified: (1) underflow of surface streams; (2) subterranean flowing streams; and (3) subterranean percolating waters. The underflow of a surface stream is considered to be a part of the watercourse itself. Rights in the watercourse include rights to the underflow. The rules governing rights to water quality of watercourses and lakes are equally applicable to their underflows. A subterranean flowing stream is a definite stream of water that is flowing through a definite underground channel. At law it is treated like a watercourse, and the rules governing water quality are equally applicable. Subterranean percolating waters are all waters slowly filtering or seeping through the ground that are not a part of a watercourse or an underground flowing stream. Subterranean waters are presumed to be percolating waters until proven to be flowing waters. At common law the owner of the land was the absolute owner of all percolating waters thereon, and was responsible to no one for pollution. This theory is still used in some jurisdictions with exceptions. Other jurisdictions apply correlative or riparian rights, appropriative rights, or combined correlative and appropriative rights systems to percolating waters, and apply the rules governing watercourses and lakes in their system to percolating waters. (Watson-Fla)
W69-02318

POLLUTION OF WATER ON THE SURFACE OF THE GROUND BUT NOT IN DEFINED CHANNELS OR DEPRESSIONS,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3 Water Pollution and Quality Controls, 1967, pp 122-124.

Descriptors: *Surface runoff, *Channels, Subsurface waters, *Riparian rights, Appropriation, Invasion, Prior appropriation, Water rights, Priorities, Competing uses, *Reasonable use, Water pollution.
Identifiers: Liability.

Pollution that interferes with the use of diffuse surface water does not often occur. General rights to the use of diffused surface waters cannot be acquired, either in the riparian or the appropriative water-rights systems. Consequently, defendant's pollution of such waters, by use or otherwise, cannot interfere with any right of the plaintiff to the use of such waters. If and when rights do attach, defendant's liability for pollution that interferes with plaintiff's use of such waters will be governed by the same general rules that apply to appropriative rights to waters in watercourses and lakes or in subterranean waters. Under the rule of the Restatement of Torts, a possessor's use of surface water on his land which pollutes the waters so as to interfere with another's use of them on other land is ordinarily reasonable; the possessor is not subject to liability unless the primary purpose of his use is to harm the other. This rule is said to be a crystallization of the principle of reasonable use generally applicable to the use of land. This rule is intended to apply only to the direct use of surface water. (Watson-Fla)
W69-02319

SOME FORMS OF ABSOLUTE LIABILITY FOR WATER POLLUTION,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3 Water Pollution and Quality Controls, 1967, pp 133-136.

Descriptors: *Water pollution, Water rights, Reasonable use, *Invasion, *Riparian rights, Sewage, *Legislation.

Identifiers: Absolute liability, Negligence per se, Purveyor.

Certain forms of water pollution are said to be unreasonable per se, as a matter of law. Absolute liability may arise because of the nature of the water rights involved; for example, pollution by an intentional invasion from a nonriparian use is unreasonable per se when it causes substantial harm to the riparian use of a riparian owner. Liability per se may be based on the nature of the pollutant such as the discharge of untreated sewage. A penal statute may establish the standard of a reasonable man, violation of which is negligence per se. Negligence per se is applicable only in the case of an unintentional invasion. To prevail in a cause of action based upon liability per se, plaintiff must plead and prove three elements: (1) defendant has violated a statutory proscription against pollution; (2) plaintiff has suffered substantial harm; and (3) defendant's pollution in violation of the statute caused plaintiff's damages. Neither a public or private water purveyor are held to strict liability for the purity of water which they distribute for consumption and domestic use. Either, however, can be held liable if negligence is proven. (Watson-Fla)
W69-02321

JUDICIAL REMEDIES AGAINST POLLUTION,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp 136-171.

Descriptors: Water pollution, Water rights, Reasonable use, Invasion, Riparian rights, *Remedies, Water quality, *Abatement, *Damages, *Competing uses, Legislation, Eminent domain.
Identifiers: Declaratory relief, Injunction.

Remedies available to protect private rights to water quality include declaratory relief, quiet title decree, abatement by self-help, damages, and injunction. Declaratory relief or a quiet title decree should be available under the law of the applicable jurisdiction. Abatement by self-help is allowed where, under the law of the particular jurisdiction a person is privileged to go upon the land of another to abate a private nuisance. Almost all private litigation over water pollution is brought to recover damages or to obtain an injunction, or both. Remedies must always be considered in light of the different kinds of harm that defendant may inflict upon plaintiff by water pollution. The primary consideration in determining money damages for water pollution is whether the plaintiff has suffered temporary or permanent damage. Injunctive relief is available to plaintiff to prevent continuance or to ameliorate some effects of defendant's pollution that causes or threatens to cause substantial harm to plaintiff's interest in the use of water. The determination of defendant's liability for a nuisance involves a balancing of conflicting interests. Even if the defendant loses this balancing of interests and has to pay damages his pollution may not be flagrant enough to warrant an injunction. (Watson-Fla)
W69-02322

DEFENSES IN WATER-POLLUTION LITIGATION,
Burton J. Gindler.
In R. E. Clark's Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, 1967, pp 171-190.

Descriptors: *Water pollution, Water rights, Reasonable use, Invasion, Riparian rights, Remedies, *Damages, Competing uses, Legislation, *Easements, *Prescriptive rights, Legal aspects.
Identifiers: Injunctions, Defenses, Negligence, Assumption of the risk.

The holder of a water right may grant an affirmative easement by which another person may cause what would otherwise be a wrongful pollution of the holder's water supply. The defendant in a water pollution case may also defend on the ground that he has acquired an easement of pollution by prescription. This is accomplished most often by the running of the statute of limitations and merger of prior judgments. The defendant can also use contributions to the pollution made by others as a defense. This defense does not prevent recovery, but it does allow the defendant to bring in other liable parties to share the damages. Although there is some old authority that plaintiff is barred from any remedy resulting from a pollution to which he contributed, the contributory-pollution defense alone will usually not bar recovery. It will, however, limit defendant's liability for the damages. Contributory negligence of plaintiff is a possible defense only if defendant's activity is merely negligent, causing an unintentional invasion rather than an intentional one. Generally assumption of the risk, the plaintiff acquiring the property with knowledge that the pollution was occurring, is no defense. (Watson-Fla)
W69-02323

LEGAL ASPECTS OF PENNSYLVANIA WATER RESOURCES PLANNING,
Pennsylvania State Univ., University Park. Institute for Research on Land and Water Resources.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02324

RELATIVE ROLES OF LAW AND ECONOMICS IN THE FORMULATION OF WATER POLICY,
Wyoming Univ.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02325

DEVELOPING TRENDS IN WATER LAW IN THE EASTERN STATES,
Department of Agriculture, Economic Research Service.
Harold H. Ellis.
Proceedings of the Water Resources Law Colloquium, Institute for Research on Land and Water Resources, Information Report No 51, pp 24-45, July 1967. 22 p, 38 ref.

Descriptors: *Legislation, Administrative agencies, Judicial decisions, Legal aspects, *Water law, *Water permits, *Riparian rights, Percolating water, Streams, Low-flow augmentation, Interstate compacts.

The courts in the eastern states rely heavily on the riparian doctrine. Riparian land, natural flow, unity of title, use of water on non-riparian land, public rights, reasonable use and several concepts connected with riparian rights are discussed. Diffused surface water may, according to the few cases on the point, be used almost entirely as the owner of the land upon which they occur sees fit. Most cases involving such waters deal with drainage. Underground streams are governed by the riparian doctrine. The rules applying to percolating groundwater are discussed. State legislation ranges from mere codification of court-made rules to far reaching adjustments. Water-use permit systems are discussed, with special reference to Iowa, Minnesota and Mississippi. Statutes allowing use of water on non-riparian land are outlined. Provisions are made by some statutes for water storage during high-flow periods for use during periods of low flow. Pollution control statutes are mentioned. Some states have utilized special districts or authorities to implement water policy. Floodplain zoning is mentioned. New developments are discussed and new approaches to water problems such as inter-disciplinary research and interstate cooperation are suggested. (Williams-Fla)
W69-02326

TRANSITION FROM RIPARIAN DOCTRINE,
Mississippi Univ., School of Law.
William M. Campion.
Proceedings of the Water Resources Law Colloquium, Institute for Research on Land and Water Resources, Information Report No 51, pp 46-57, July 1967. 12 p.

Descriptors: *Mississippi, Administrative agencies, *Riparian rights, *Prior appropriation, Water permits, Legislation, *Competing uses, Relative rights, Water law, Legal aspects, Administration, Political aspects, Droughts.
Identifiers: Vested rights.

Drought conditions, a desire to lure industry and concern of conservationists prompted the 1956 Mississippi legislature to adopt a prior appropriation-type water allocation law. Study by the Mississippi Water Resources Policy Commission is discussed. The Commission studied climate, pollution, surface waters, irrigation, watersheds, and groundwater. The Commission also studied water uses and needs of agriculture, industry, and municipalities. In its report to the 1956 legislature the Commission recommended the adoption of a prior appropriation system. The statute protects vested riparian rights, and provides basically for a permit system. Average minimum flows are to be established and no permits granted which would invade them. Permits define the extent of the appropriation right. Non-use or unauthorized use for a period of three years results in a forfeiture of the right. Permit rights are transferrable with the land. Exclusions from the law are discussed, and it is pointed out that the statute does not recognize surface and groundwater inter-relationships or provide adequate police powers. The Act's primary purpose is to resolve conflicts among competing users. 92 percent of the requests for permits were made by owners of vested riparian rights. Suggestions for adopting prior appropriation in Pennsylvania are made. (Williams-Fla)
W69-02327

EMINENT DOMAIN--RIPARIAN RIGHTS--DEPRIVATION OF ACCESS TO NAVIGABLE WATERWAY IS NOT COMPENSABLE--COLBERG V STATE,
Ruth R. Budd.
Boston College Ind and Com L Rev, Vol 9, No 3, pp 770-780, Spring 1968. 11 p, 53 ref.

Descriptors: *California, Judicial decisions, Riparian rights, Riparian land, *Navigable waters, Navigation, *Compensation, Eminent domain, *Access routes, Highways.
Identifiers: Property rights.

This is a case comment on Colberg v State (432 P 2d 3 (1967)). The State of California proposed to construct twin stationary freeway bridges across a channel, cutting off plaintiffs' riparian land, where they operated shipyards, from access to navigable waters and the sea. The height of the bridges would cut off 81 percent of one company's business, and 35 percent of the other's. On appeal, the California Supreme Court held that plaintiffs' rights of access to navigable waters were burdened with a servitude in favor of the state. Diminution of that right by a valid exercise of the state's power to deal with its navigable waters was not compensable. This case is contrasted with analogous cases involving impairments to street access by freeways. The case is criticized in that it actually does deprive the riparian owners of a private property right, free navigation, without compensation. The rule used in this case is even broader than the federal servitude theory. The background of the California rule is discussed, and the case is generally criticized for its apparently narrow approach to compensable property rights. (Williams-Fla)
W69-02328

AUSTRALIAN AND AMERICAN WATER ALLOCATION SYSTEMS COMPARED,
Peter N. Davis.
Boston College Ind and Com L Rev, Vol 9, No 3, pp 647-710, Spring 1968. 64 p, 343 ref.

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Descriptors: Legislation, Prior appropriation, Riparian rights, *Water permits, *Water policy, Water law, Administrative agencies, *Water allocation (Policy), *Administration, Competing uses, Distribution, Water rights, Preferences (Water rights).

The riparian doctrine is questioned as being adequate to meet the task of water allocation in the eastern United States. Australia employs a temporal non-priority permit system of water allocation. A government agency issues water use rights, permits and licenses and may revoke them without regard to the time of issuance, much like the system in Minnesota. The history of the development of Australian irrigation areas, legal problems posed by the change from the common-law riparian doctrine to licensing, and the licensing statutes are discussed. Any good system of water allocation should: (1) provide secure rights; (2) maximize efficiencies; (3) be flexible enough to allow new uses; (4) protect the public interest; and (5) rely mainly upon private rights. The riparian system, prior appropriation system, temporal non-priority permit system, and marketplace concepts are said to be the four major water allocation concepts in the United States. Each is analyzed in detail with reference to its fulfillment of each of the five requirements of a good water allocation system. The concludion is drawn that riparianism and prior appropriation are becoming outmoded, and that the temporal non-priority permit system would be the most appropriate system for the eastern states. (Williams-Fla)
W69-02329

WATER-SUPPLY STRINGENCIES--FEATURES, ANTECEDENTS AND OBSTACLES TO RESOLUTION,
U. S. Geological Survey.
Arthur M. Piper.
Boston College Ind and Com L Rev, Vol 9, No 3, pp 633-646, Spring, 1968. 14 p, 34 ref.

Descriptors: Natural streams, Streams, Groundwater, Hydrologic aspects, Reservoirs, Surface waters, Consumptive use, Irrigation effects, *Riparian rights, *Prior appropriation, *Beneficial use, *Competing uses, Water conservation, Reasonable use, Water yield improvement, Water control, Water management (Applied), Administration.

As water supply facilities are outgrown many centers of large water demand will turn to interregional transfers of water. To reduce the problems inherent in such projects, optimum reuse of local supplies must be made. One method is to improve water quality of streams through pollution control. But even when regulated to the utmost, it is doubtful that our streams can deliver projected supply requirements. The principle of an absolute and timeless water right imbedded in the prior appropriation and riparian rights doctrines impairs resolution of quantity and quality problems. Risk of forfeiture accompanying failure to use the appropriated amount has led to wasteful irrigation practices in the West. In addition there are no effective methods for adjustment of water rights to accommodate changing purposes. Municipalities inefficiently sterilize all water delivered when only a small percentage of use requires sterilization. The controlling policy is devising new water management policies should be reappraisal of individual rights against total water supply commitment and requirement. The police power might be exercised to periodically verify or adjust withdrawal in relation to continuing use. Preferably, water conservancy districts might be created with jurisdiction over an entire natural water supply to exercise all participating water rights jointly for optimum advantage. (Kahle-Fla)
W69-02330

DEEP-WELL DISPOSAL OF WASTES,
U. S. Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 05E.
For abstract, see .
W69-02342

6G. Ecologic Impact of Water Development

POWER OF MASSACHUSETTS METROPOLITAN PARK COMMISSION.

Mass Ann Laws, Ch 92, Sec 33, 38, 39 (1966).

Descriptors: *Massachusetts, *Administrative agencies, Parks, *River regulation, Legislation, Rivers, Ponds, Recreation, *Recreation facilities, Regulation, Water pollution control, River basins, Water rights, Cities, Planting management, Maintenance, Trees, Shrubs, River basin development, Water supply.

Section 33 empowers the commission to regulate the use of spaces along rivers or ponds to make them more available as spaces for recreation. The commission is authorized to maintain these spaces, and to plant, maintain, and remove trees and shrubs within them. The section does not limit the existing rights of any town in relation to water supply purposes. Section 38 authorizes the commission to make rules and regulations, not impairing freight traffic for the care, maintenance, protection and policing of the Charles River basin. Violations of such rules are declared breaches of the peace punishable by fine not exceeding $50. The commission shall publish the rules once in a Boston newspaper. This shall constitute sufficient notice to all persons. The sworn certificate of any member of the commission shall be prima facie evidence of such publication. A copy of a rule attested by any member shall be prima facie evidence that the rule was made by the commission. Section 39 empowers the commission to make regulations prohibiting pollution of the Charles River within the metropolitan park district. Violation is punishable by fine not exceeding $1000. (Smodish-Fla)
W69-02032

RIGHT OF PUBLIC TO FISH IN STREAM NOTWITHSTANDING OBJECTION BY RIPARIAN OWNERS,
J. H. Crabb.
47 ALR 2d 381-418.

Descriptors: Riparian land, *Riparian rights, *Fishing, Navigable rivers, Rivers, Streams, *Navigable waters, Riparian waters, Recreation, Running waters, Banks, *Nonnavigable waters, Public rights, Shellfish, Judicial decisions, Ownership of beds, Watercourses (Legal), Prescriptive rights.

Fish are generally considered to be the property of no one unless they are removed from the water or confined in private water, from which there is no reasonable possibility of their escape. Even though fish while uncaptured are not subject to private exclusive proprietorship in certain waters. Rules governing bodies of water such as lakes, bays, and arms of the sea are beyond the scope of the annotation. The exclusive right to fish in adjacent waters is not necessarily an inherent incident of riparian ownership and most issues discussed arise as an action of trespass by the riparian owner against a defendant who had been fishing in the stream flowing by the plaintiff's banks. Generally fishing in navigable streams is open to the public and is not subject to exclusive riparian ownership or control, while fishing rights in nonnavigable streams are privately owned by the adjacent riparian owners. (Smith-Fla)
W69-02056

CONTROLLING INDUSTRIAL WATER POLLUTION: COLOR THE PROBLEM GREEN,
Iowa Univ. Law School.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02331

07. RESOURCES DATA

7A. Network Design

COUNTY RAIN-GAGE NETWORK USEFUL IN DESIGN,
A. R. Pagan, and R. Rothenberg.
Civ Eng, Vol 35, No 4, pp 68-9, April 1965.

Descriptors: *Rain gages, Design, *Drainage system.

Bergen County, NJ, supplements two recording rain gages with 13 nonrecording gages read and reported by unpaid volunteers; small plastic gages are used; information gained serves to supplement data from U S Weather Bureau for design of drainage structures; readings in one case proved unusual rainfall in small area and indicated no need for additional facilities.
W69-02078

SECONDARY MOTIONS APPLIED TO STORM SEWAGE OVERFLOWS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02109

DESIGN, CONSTRUCTION AND PERFORMANCE OF VORTEX OVERFLOWS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02114

HYDRAULIC ASSUMPTIONS IN CALCULATING STORM-WATER OVERFLOWS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02119

FOCUS ON RESEARCH. WATER POLLUTION RESEARCH AND THE MUNICIPAL ENGINEER,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02126

HOW TO SIZE CONDUITS FOR STORM SEWERS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02184

SOME APPLICATIONS OF RESEARCH IN THE DESIGN OF SEWERAGE AND SEWAGE-TREATMENT WORKS,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02233

7B. Data Acquisition

TV GOES UNDERGROUND AT FORT LAUDERDALE,
C. S. McKinney, R. W. Campbell, and F. C. Funnell.
Water Poll Control Fed J, Vol 38, No 2, pp 179-85, Feb 1966.

Descriptors: *Equipment, Sewers.
Identifiers: *Leak detection.

Small TV camera was used for viewing inside of pipe lines and locating failures of PVC jointed terra-cotta pipe to obtain data necessary to repair constantly developing leaks; equipment included aluminum paneled van-type truck outfitted with

portable generator for power, intercom system and radio for communications, cupboards and cabinets for storage, and air conditioning unit to keep truck and equipment cool for efficient operation; camera, 6 3/4 in. in diam, had as its light source six miniature floodlights mounted around lens.
W69-02075

FLOW MEASUREMENT,
V. C. Parker.
Louisiana State Univ-Div Eng Res-Bul 89, pp 116-27, 1967.

Descriptors: *Flow measurement, *Flowmeters, Weirs.

Measurement of water and waste-water flow with rate-of-flow meters and quantity meters; design and application of rate-of-flow meters discussed includes variable-head, variable area-constant head, electromagnetic, and sonic velocity meters; rough field measurements; features of rectangular, V-notch, trapezoidal, parabolic notch, and broad-crested weirs are reviewed.
W69-02080

THE SYSTEMATIC ERROR IN RAINFALL MEASUREMENT,
J. C. Rodda.
J Inst Water Eng, Vol 21, No 2, pp 173-177, March 1967.

Descriptors: *Rain gages, *Standards, Rain.

Various methods for overcoming the effect of wind on the amount of rain collected by a rain gauge are discussed. It has been found that a rain guage at ground level gives the measurement approaching closest to the real rainfall, but this is still not the real solution to the problem. No absolute standard for rainfall measurement is yet available, as there is for stream flow, and it appears to the author that only a small amount of progress is possible without one. In the past a simple rule has been adopted -- that the guage giving the largest catch is the best. The author feels that this cannot be sufficient justification for a guage in the future; neither can the use of a particular guage for 100 years be used as an adequate reason for continuing to use it.
W69-02081

RADAR ESTIMATION OF RAINFALL,
A. P. Ryan.
J Hydrology, New Zealand, Vol 5, No 2, pp 100-110, 1966.

Descriptors: *Instrumentation, *Rainfall intensity.
Identifiers: *Radar measurement, Calculations.

By calibration of equipment, power back-scattered to radar by precipitation can be measured; power back-scattered depends on reflectivity of precipitation, which in turn depends on form of drop-size distribution; rainfall rate is also function of drop size distribution, and empirical relationship exists between reflectivity and rainfall rate; using this relation, measurements of received power permit estimate of rainfall rate; trials conducted overseas suggest that accuracy of factor of two can be achieved with suitable equipment on all occasions.
W69-02082

GAUGE FOR CONTINUOUSLY MEASURING RATE OF RAINFALL,
R. A. Semplak.
Rev Sci Instruments, Vol 37, No 11, pp 1554-8, Nov 1966.

Descriptors: *Rain gages, Instrumentation.
Identifiers: *Calculations.

In gage, water flows through channel type capacitor which is coupled to oscillator, thus frequency of output voltage changes with rain rate; calibration curve can be expressed mathematically as sum of two exponentials; 100 gages were fabricated and calibrated, and statistics of these calibrations are presented; based upon measured data, capacitance rain gages are found suitable for situations where continuous rainfall rate data are desired; output of gage is in form readily adapted for computer reduction.
W69-02083

AUSTRALIA DEVELOPS NEW SCIENTIFIC EQUIPMENT TO ASSESS WATER RESOURCES,
I. Stuart.
Water and Water Eng, Vol 70, No 850, pp 515-17, Dec 1966.

Descriptors: *Rain gages, Instrumentation.
Identifiers: Australia.

Tilting bucket rain gage was developed and manufactured by Rimco, Melbourne; bucket, housed in standard 8 in. gage, tilts every time 0.01 in. of rain falls on it and tilting sends out electrical impulse which may operate counter located at gage or may be recorded on charts or tape either at gage or at distance; this gage bucket is gold-plated to reduce surface tension and to help water run more easily.
W69-02084

TV INSPECTION OF SEWERS IMPROVES REPAIR PROGRAM,
H. T. Thornquist.
Public Works, p 73, Feb 1966.

Descriptors: *Sewers, *Equipment.
Identifiers: *Sewer inspection.

A miniature TV camera (used to inspect sewers 15 inches and smaller in diameter in Seattle, Wash.) is described in detail. Procedure for inspection is also described. An average day's inspection covers 1,200 ft. of sewer at an average cost of 19 cents/ft. The TV inspection has made it possible to extend the program of scheduled repairs. A savings of approximately 1/3 is estimated when repairs can be scheduled on a routine basis.
W69-02085

RAINFALL RECORDERS-COMPARISON OF DIFFERENT TYPES,
H. W. Underhill.
Int Assn Sci Hydrology-Bul, Vol 11, No 3, pp 50-5, Sept 1966.

Descriptors: *Rain gages, Instrumentation, Siphons.

Comparison was made of available recording rain gages; practical experience with certain of these instruments showed that points of design which are of particular interest are clock mechanism, siphoning time and frequency, tipping time and frequency, internal constrictions, dribbling siphon and verticality of pen travel.
W69-02086

ELBOW METER MEASURES FLOW,
P. A. Vesilind, and F. E. McJunkin.
Pub Works, Vol 98, No 12, pp 80-81, Dec 1967.

Descriptors: *Flow measurement, *Flowmeter, *Sewer hydraulics.

Elbow meter used for measuring flow rate of water in piping systems is described; any elbow in system may be used and it is not necessary to disassemble piping to install meter; elbow may be in any position--horizontal or vertical; pipe must be flowing full, however, during calibration and operation.
W69-02087

AUTOMATIC MOBILE SAMPLING AND GAGING UNIT,
R. B. Weidner, S. R. Weibel, and G. G. Robeck.
Pub Works, Vol 99, No 1, pp 78-80, Jan 1968.

Descriptors: *Storm runoff, *Sampling, *Instrumentation, Automatic control.
Identifiers: *Urban drainage, *Urban hydrology.

Unit for sampling storm-water runoff from various environments on time-proportioned or flow-proportioned basis was developed by Cincinnati, Ohio, Water Research Laboratory to facilitate urban storm-water runoff studies; operation of sampler is dependent on sufficient amount of rainfall to start electrical and cooling systems, and predetermined amount of runoff to activate sampling section.
W69-02088

THROTTLE MEASURING DEVICE OF RAIN-WATER OVERFLOWS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02100

MEASUREMENT OF STORM WATER OUTLETS IN COMBINED SEWERS BY THE THROTTLE-PIPE PROCESS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02112

AKRON MONITORS COMBINED SEWER OVERFLOWS,
E. Gates.
Pub Works, Vol 98, No 1, pp 90-1, Jan 1967.

Descriptors: *Overflow, Instrumentation, Pumping, *Equipment.
Identifiers: *Combined sewers, *Interceptor sewers, Akron (Ohio).

Description of monitor and control units for combined sewer system (see Engineering Index 1963 p 716); basic equipment consists of Tel-Eye liquid contact sensors at pump stations and connections between storms and interceptors, Telstep telemetry units signaling over leased telegraph channel lines, and master panel at sewer maintenance headquarters.
W69-02130

HOW TO ANALYZE COMBINED SEWAGE-STORMWATER COLLECTION SYSTEMS,
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-02159

DEPOSITION IN A SANITARY SEWER,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02170

SEWERS CAN BE REBUILT BY REMOTE CONTROL,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02173

RAINFALL AND EVAPORATION: DISTRIBUTION IN SPACE AND TIME,
For primary bibliographic entry see Field 02D.
For abstract, see .
W69-02247

THE ROLE OF PARAMETRIC HYDROLOGY,
University College, Galway, Ireland.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-02249

REMOTE SENSING OF WATER POLLUTION,
Sacramento State College, Sacramento, California.
Leonard W. Hom.
J Water Pollut Contr Federation, Vol 40, No 10, pp 1728-1738, Oct 1968. 11 p, 7 fig, 1 tab, 7 ref.

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Descriptors: *Remote sensing, *Water pollution, Electromagnetic waves, Infrared radiation, Mapping, Marking techniques, Measurement, Networks, Photography, Photogrammetry, Radar, Spectroscopy.
Identifiers: Remote sensing of pollution.

Remote-sensing devices, primarily those based on imaging with portions of the electromagnetic spectrum, can be valuable tools for sensing water pollution and protecting water resources. Multiband spectral reconnaissance, in which information from several portions of spectrum is used to interpret the condition of land and water, is particularly useful because it enables the interpretor to identify a feature by its 'tone signature', the unique set of tones that feature will produce in the several bands in which it is imaged. Bands may include thermal infrared and radar, as well as more usual photographic ranges. Other applications of remote sensing to water pollution may be made with microwaves, airborne magnetics, input electromagnetics, gamma-ray spectrometry, chemical vapor detection, and fluorescent processes. This method supplements, but does not replace, normal field methods.
W69-02285

LEGAL ASPECTS OF PENNSYLVANIA WATER RESOURCES PLANNING,
Pennsylvania State Univ., University Park. Institute for Research on Land and Water Resources.
Benjamin V. Dall.
Proceedings of the Water Resources Law Colloquium, Institute for Research on Land and Water Resources Information Report No 51 pp 1-14, July 1967. 14 p, 4 ref.

Descriptors: *Pennsylvania, Water law, Legal aspects, *Riparian rights, Surface runoff, Surface drainage, Base flow, *Groundwater, Judicial decisions, *Percolating water, Underground streams, Surface waters.

Policy questions regarding water are to be answered by integrating legal considerations into scientific analysis. Economics has always played an important role in water law. Water law in Pennsylvania, based on the doctrine of riparian rights, is similar to the other eastern states. Cases give the best reflection of water law. Pennsylvania has classified water according to its physical form: (1) natural watercourses and lakes; (2) surface waters; and (3) percolating ground waters. Each of these classifications involve different rules of law. A natural watercourse must have a definite channel and banks and must discharge itself into another body of water. Cases involving the question of what constitutes a watercourse are discussed. Riparian rights involve the use of water, not the ownership. Domestic and nondomestic uses are discussed. Underground streams are generally treated in the same way as surface streams. Surface waters have no definite course or substantial or permanent existence. Most cases concerning surface waters involve repeling them and there is not much question that consumption of surface waters is legal. The reasonable use doctrine has been adopted with regard to percolating waters. Constitutional problems suggested by the revision of water law by statute are mentioned. (Williams-Fla)
W69-02324

RELATIVE ROLES OF LAW AND ECONOMICS IN THE FORMULATION OF WATER POLICY,
Wyoming Univ.
Frank J. Trelease.
Proceedings of the Water Resources Law Colloquium, Institute for Research on Land and Water Resources Information Report No. 51, pp 15-23, July 1967. 9 p, 6 ref.

Descriptors: Prior appropriation, Benefits, Costs, Economic efficiency, Evaluation, *Economics, Cost-benefit analysis, *Water law, Administration, Water management (Applied), *Competing uses, Riparian rights, Water resources development, *Water policy.

Water law ideally should provide for maximum benefits through the granting of private property rights. These should be regulated only when private economic action does not protect the public interest. Property rights must be secure enough to encourage development and still be flexible enough to change when economics so dictates. Since it is impossible to know just what the maximum benefits are, economics should only attempt to give direction toward the maximum benefits. The use of private property rights leaves the decisions as to the most productive and wisest uses in the hands of the owners, instead of having government make every decision. This leads to maximization without strict regulation. Water law must facilitate a shift from existing uses to new uses. The use of the economic marketplace is the best guarantee of flexibility. Of course, some regulation is necessary to insure protection of the public interest. The cost-benefit analysis should be used by public authorities to decide if the overall benefits of a proposed use out-weigh the overall costs. However, intangible factors can cause difficulties in the use of this type of analysis. Various reasons for having to superimpose at least some regulation on the market are discussed. The doctrine of riparian rights is criticized as not promoting a beneficial overall water policy. (Williams-Fla)
W69-02325

HUMIDITY SENSOR: PERMANENT ELECTRIC HYGROMETER FOR CONTINUOUS MEASUREMENT OF THE RELATIVE HUMIDITY OF THE AIR,
Michigan State Univ., East Lansing.
George J. Bouyoucos, and R. L. Cook.
Soil Science, Vol 100, No 1, pp 63-67, July 1965. 5 pp, 2 fig, 2 tab.

Descriptors: *Hygrometry, *Humidity, *Temperature, Electrical conductance, *Air, Electrodes, Electrical resistance, *Measurement, Calibrations, Evaporation, Instrumentation, Wetting, Drying.
Identifiers: *Relative humidity, *Hydrocal, *Sensors.

A new electric hygrometer was designed to measure relative humidity of the air. The hygrometer uses long and wide stainless steel electrodes cast in gray hydrocal. The hydrocal acts as a sensor and measures relative humidity electrically. Electrical resistance varies as relative humidity varies. Special conductivity bridges have been used in the gray hydrocal hygrometer to measure relative humidity by measuring its electrical resistance. The saturated salt method is used to calibrate the hygrometer. The unit has been subjected to a variety of climatic conditions for over one year without any significant change taking place in its calibration. Sensitivity of the unit can be varied by changing distance between electrodes. Temperature changes do not exert significant influence on the relative humidity measurement of the hygrometer. A significant fact is that the unit possesses a hygroscopic property that is not destroyed by washing with distilled water. The hygrometer can be used in arid climates to measure relative humidity of the air, which is an indication of evaporation when formulas such as Penman's are used. (Blecker-Ariz)
W69-02374

COMPARISON OF WATER POTENTIALS IN LEAVES AS MEASURED BY TWO TYPES OF THERMOCOUPLE PSYCHROMETER,
CSIRO, Griffith, N.S.W., Australia, Irrigation Research Laboratory.
For primary bibliographic entry see Field 02I.
For abstract, see .
W69-02375

WATER LEVEL FLUCTUATION IN EVAPOTRANSPIROMETERS,
U. S. Geological Survey, Phoenix, Arizona. Water Resources Div.
For primary bibliographic entry see Field 02D.
For abstract, see .
W69-02382

REMOTE SENSING FOR ESTIMATING SOIL SALINITY,
Agricultural Research Service, Soil and Water Conservation Research Div.
Victor I. Meyers, David L. Carter and William J. Rippert.
J. Irrig and Drain Div. ASCE. Vol 92, No IR 4, Proc Paper 5040, pp 59-68, Dec. 1966.

Descriptors: Arid lands, *Remote sensing, *Saline soils, Water table, *Aerial photography, Salt tolerance, *Temperature, Leaves, Cotton, *Infrared radiation, Crop response, Sampling.

Many soils in arid areas of the world are affected by high water tables and resultant soil salinity. Detection of the saline areas and of the degree of salinity in the rooting profile is of considerable interest to agricultural workers involved in reclamation of these soils. Cotton was used as an indicator plant to relate the salinity in the 0 to 5 ft. profile at some reference locations to that at a number of prediction sites where the salinity was unknown. Aerial photographs were taken using ektachrome infra red aero film for observing the salinity-affected cotton. On the basis of color tones it was possible to distinguish five levels of salinity. Infra red radiometer measurements of cotton leaf temperatures were made on the ground and from an airplane. Statistical studies of the temperature data taken on the ground indicated that soil salinity could be predicted from cotton leaf temperatures with reasonable accuracy. (Affleck-Ariz)
W69-02385

7C. Evaluation, Processing AND Publication

SEWER DEPTH OF FLOW DETERMINATION,
Robert C. Wilging.
Water and Sewage Works, Vol 109, 103, March 1962.

Descriptors: *Sewers, Pumping, Manholes, *Flow measurement, Storm runoff.
Identifiers: Storm sewers, *Capacity.

A procedure to determine the present sewer capacity available to receive pumped sewage from adjacent areas is described. Sticks, one by one inch, grooved on one side and provided with glass vials were placed in selected sewer manholes. Appropriate numbers of vials, regularly checked, provided information of the maximum flow occurring in the period between readings. Information on the influence of rainfall on the flow of sewers in certain areas not served by storm sewers was collected. The information obtained helped to place pumped sewage in areas where sewers were not overloaded even after heavy rainy conditions.
W69-02089

THE STORAGE AND DISCHARGE CAPACITIES OF SEWERAGE AND THE OPERATING FREQUENCY OF STORM OVERFLOWS: DUTCH METHOD OF CALCULATION,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02101

ON MEASUREMENTS OF STORM-SEWAGE OVERFLOWS - A GRAPHICAL METHOD,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02111

THE EFFECT OF DELAYED DISCHARGE ON THE CALCULATION OF STORM-SEWAGE OVERFLOWS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02120

NEW PRINCIPLES FOR THE ARRANGEMENT OF STORM WATER OVERFLOWS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02149

NEW PROCESS FOR SIMPLE CALCULATION OF DILUTION VALUES FOR STORM WATER OVERFLOWS IN COMBINED SEWERAGE SYSTEMS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02150

SOLUTION FOR STORM SEWER SYSTEM PROBLEM,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02186

THE APPLICATION OF STORAGE CAPACITY TO THE DESIGN OF SEWERS,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02194

SIMPLIFIED SEWER DESIGN,
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02198

EMPIRICAL MODEL FOR PREDICTING DRAINAGE SYSTEM PERFORMANCE,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02201

DESIGN OF STORM SEWER SYSTEMS,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02204

ROLE OF DIGITAL COMPUTERS IN HYDROLOGIC FORECASTING AND ANALYSES,
J. P. McCallister.
Int Geodetic and Geophysical Union-Sec for Sci Hydrology Publ, No 63, pp 68-76, 1964. 3 charts.

Descriptors: *Computer programs, *Rainfall-runoff relationships, *Runoff forecasting, Hydrographs.
Identifiers: *Calculations.

Major goal of river forecasting computer model is to conserve as much continuity as possible between forecaster and his forcast product; computer will provide mathematically exact computation; four hydrologic subroutines required to develop forecast program are rainfall-runoff computation, unit graph computation, stream flow routing and reservoir routing.
W69-02245

STUDY OF R R L HYDROGRAPH METHOD OF DESIGNING SEWER SYSTEMS,
E. G. W. Oliver.
Chartered Mun Engr, Vol 90, No 12, pp 377-82, Dec 1963.

Descriptors: *Hydrographs, *Design, *Sewers, Rainfall intensity, Outlets.
Identifiers: *Calculations.

Hydrograph method of design considers changing situation over drainage area and in network of sewers at equal intervals of time, usually of one minute; calculation reflects minute-by-minute variation in contributing area, rainfall intensity and volume of water stored; flow diagram, or hydrograph, is evaluated and rate of flow at outfall is shown after each minute; comparison is made with conventional rational method.
W69-02250

COMPARISON OF SOME FORMULAS FOR DETERMINING THE SNOW MELT (PRELIMINARY RESULTS),
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02252

ON THE IMPORTANCE OF VOLUME DISTRIBUTION IN THE CALCULATION OF DRAINAGE SYSTEMS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02254

USE OF ANALOG MODELS IN ANALYSIS OF FLOOD RUNOFF,
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02261

DOUBLE-MASS ANALYSIS ON COMPUTER,
For primary bibliographic entry see Field 02B.
For abstract, see .
W69-02263

REAL-TIME DIGITAL PROCESSING OF UNSTEADY-FLOW VARIABLES,
Iowa Univ., Iowa City, Iowa Institute of Hydraulic Research.
John R. Glover, and Arthur R. Giaquinta.
J Hydraul Res, Vol 6, No 3, pp 219-232, 1968. 14 p, 2 fig, 5 ref.

Descriptors: *Analog computers, *Digital computers, *Data processing, Computer programs, Data transmission, Programming languages.
Identifiers: Analog-digital conversion.

The application of digital computers to the handling of unsteady-flow variables usually collected in analog form is discussed. The conversion of analog to digital data by the IBM 1801 Data Acquisition System is described and the effect of time of conversion on precision of translated data is discussed. Programming languages both for conversion and processing of data are discussed with particular reference to their usefulness for hydrologic work and their efficiency with respect to a professional programmer's needs. (Knapp-USGS)
W69-02288

AUTOMATIC PROCESSING OF CURRENT METER DATA,
Laboratoire d' Hydraulique de Toulouse, et Laboratoire associe an Centre National de la Recherche Scientifique, Toulouse, France.
L. Castex, J. Piquemal, and H. Saby.
J Hydraul Res, Vol 6, No 3, pp 211-218, 1968. 8 p, 5 fig.

Descriptors: *Instrumentation, *Current meters, *Computers, Digital computers, Measurement.
Identifiers: *Digital recorders, Analog-digital converters.

A system for the automatic processing of current-meter data is described. The equipment is fully portable and suitable for both field and laboratory use. As many channels are used as current meters. The current-meter signals are converted to digital information displayed on a panel. A gaging operation involving measurement of 270 velocity points each taking 200 sec to record can be completed by one operator in about 2 hours. (Knapp-USGS)
W69-02291

SIMPLIFICATIONS OF GROUND-WATER DATA USED FOR AN ANALOGUE OF A COASTAL AQUIFER,
Water Research Assoc., Medmenham, Buckinghamshire, England.
A. Hunter Blair.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 59-65, Sept 1968. 7 p, 5 fig, 3 ref.

Descriptors: *Analog models, *Saline water intrusion, *Aquifers, *Saline water-freshwater interfaces, Steady flow, Non-uniform flow, Drawdown.
Identifiers: Lincolnshire (England), Chalk aquifer.

An electric analog model study was made of the chalk aquifer of North Lincolnshire, England. The aquifer is about 300 ft thick and dips east. The western part crops out and the eastern part is confined by glacial deposits. In the study area, on the east coast of England, overpumping has caused some salt water intrusion. Transmissibility was determined by pumping tests and compared with T values estimated from regional water table slopes and total discharge. A steady state model of 1500 nodes, modeling about 300 sq mi, was constructed with a mesh spacing of 0.5 mi. The model was adjusted to agree with observed water levels. A non-steady state model was made, representing a flow band across the southern half of the steady state model, to study the relationship between applied pumping rate, position of the well relative to the coast, and applied infiltration. To simplify the problem it was necessary to assume uniform infiltration, steady pumping rate when the pump was on, vertical saltfresh water interface, no zone of mixing, equal viscosity, and no lateral flow. It was found that beyond 440 ft from the coast, 90-100% of infiltration may be pumped without salt water intrusion. Maximum encroachment occurs at a well 0.5 mi from the sea. When total pumpage is held to 90-100% of infiltraton, pumping rate had no significance on net encroachment of saline water. (Knapp-USGS)
W69-02344

NUMERICAL STUDIES OF UNSTEADY DISPERSION IN ESTUARIES,
Massachusetts Institute of Technology, Cambridge, and Gibbs and Hill, Inc., Boston, Massachusetts.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-02346

A MATHEMATICAL MODEL FOR TRANSIENT FREE SURFACE FLOW IN NONHOMOGENEOUS OR ANISTROPHIC POROUS MEDIA,
Acres Ltd., Niagara Falls, Canada.
B. A. Szabo, and I. W. McCraig.
Water Resources Bull, Vol 4, No 3, pp 5-18, Sept 1968. 14 p, 8 fig, 2 tab, 13 ref.

Descriptors: *Model studies, *Analog models, *Computer models, *Mathematical models, *Porous media, Free surfaces, Water table, Drawdown, Anisotropy, Darcys law, Dupit-Forcheimer theory.

A mathematical model was developed to solve a steady free surface flow problem and a rapid drawdown problem in a two-dimensional porous medium. The same problem was also solved by an analogue device and excellent agreement was found to exist between the two solutions. This paper contains the formulation of the numerical problem from first priniciples and a discussion of measures that had to be taken in order to assure numerical stability and proper convergence of the solution. Although the scope of this study was limited to a two-dimensional flow case, the elements of simulation discussed are general in nature and applicable to three-dimensional problems. It was demonstrated that numerical solutions can be obtained for the position of the free surface at given time intervals, for the piezometric head distribution within the flow field and for flow quantities across given boundaries. In addition, the mathematical model will permit consideration of

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nonhomogeneous or anisotropic characteristics of the porous medium, without difficulty. It is concluded that mathematical models in conjunction with analog control devices can be efficient and reliable tools for solving complex porous flow problems. (Author)
W69-02353

08. ENGINEERING WORKS

8A. Structures

IN RE LAKE SADAWGA DAM (ADMINISTRATIVE JURISDICTION OVER CERTAIN DAMS).
159 A 2d 337-340 (Vt 1960).

Descriptors: *Vermont, *Administrative agencies, *Jurisdiction, *Dams, Judicial decisions, Administrative decisions, Water law, Adjudication procedure, Legislation, Safety, Water levels, Spillways, Height, Width, Outlet works, Hydroelectric power, Supervisory control (Power), Ponds.
Identifiers: Presumptions, Evidence.

The owner of a dam appealed from an order of the State Water Conservation Board requiring him to make specified changes in the height and width of the spillway for safety reasons. The water conservation board had jurisdiction over certain dams and the public service commission over certain others. The court held that under such circumstances, jurisdiction must affirmatively appear in each case. Although an appellate court is generally required to assume that a court of general jurisdiction regularly acquired and lawfully exercised its jurisdiction, no such presumption arises where the lower court is one of limited or special jurisdiction. A public administrative body has such jurisdiction as is conferred on it by statute, and the board must determine and make findings of the facts necessary to show that the power it exercised did exist. Since the board made no jurisdictional finding supported by the evidence, it had no basis for issuing its order, and consequently, the order was invalid. It was further held that an order should be directed to a condition which exists at the time the order is entered, and not at the time of the initial proceedings. (Smodish-Fla)
W69-02044

SOUTH SASKATCHEWAN RIVER PROJECT,
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-02076

STORM SEWER TUNNEL 'THREADS NEEDLE' BETWEEN HIGHWAY BENTS,
W. D. Murphy.
Pub Works, Vol 95, No 8, pp 95-6, Aug 1964.

Descriptors: *Tunnel construction, *Drainage, *Storm runoff, Highways.
Identifiers: *Storm sewers, Houston (Texas).

Techniques described were used in project for Texas Highway Dept; 11 1/2-ft boring machine was pushed 6500 ft passing between 75 sets of proposed freeway columns with tolerance of 18 in. on either side; tunnel was bored under downtown Houston on sewer project which required 6947-ft long, 8 1/2-ft ID monolithic concrete storm sewer to carry drainage water from depressed section of Highway 59 near center of city.
W69-02077

DOUBLE-BARRELED CLAY-PIPE SEWER,
Lyall A. Pardee.
Amer City, pp 82-83, Dec, 1966.

Descriptors: *Sewers, *Construction, *Velocity, *Corrosion, Design.
Identifiers: Los Angeles (Calif.).

A sewer line consisting of two 42 in. clay pipelines running parallel in a common trench reinforced with concrete bedding cradles was designed to solve a corrosion problem in the Los Angeles area. It replaced 7,838 feet of a reinforced concrete pipe sewer lined with clay plates that was subject to acid attack. The section replaced was part of a gravity line following a steep grade. A combination of the high-velocity flow and H_2SO_4 concentration caused corrosion of the concrete at a rapid rate. Design and construction of the new clay pipeline are briefly discussed.
W69-02079

MODEL INVESTIGATIONS OF DIFFERENT TYPES OF STORM-WATER OVERFLOWS AND THEIR EFFECT ON THE SEWAGE WORKS AND THE RECEIVING STREAM,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02091

THE PERFORMANCE OF STILLING PONDS IN HANDLING SOLIDS,
M. R. Frederick.
In Symposium on Storm Sewage Overflows, May 4, 1967. Sponsored by the Institution of Civil Engineers.

Descriptors: *Stilling basins, Storm runoff, Discharge (Water), *Weirs, Design, Siphons, Equipment.
Identifiers: *Suspended solids, Capacity.

The total capacity of a stilling pond may be sufficient to prevent discharge in storms of short duration and moreover, the solids dislodged from the sewer in the early part of the storm flow may be retained and passed into the sewer when flow subsides. The behavior of gross solids was investigated to determine how the pond may be proportioned to minimize the quantity of solids in the discharge. The essential features of the type of stilling pond under consideration are illustrated, as well as the form and action of the air-regulated siphon and the water circuit. The experiments were arranged first to establish a valid technique on a pond of specified geometry, and then to use this technique to examine and develop geometrical shapes which appeared to offer the possibility of high efficiency. Tests were made to compare the performance of a rectangular stilling pond with that of a side weir and that of a fan-shaped chamber with an end weir. The rectangular design is shown to be superior in its handling of gross solids. From the tests and with VC (1/2)D/U as a parameter, recommendations are given for design dimensions of: (a) pond size, (b) siphon type and position, (c) scum board size, and (d) invert shape. The efficiency of a pond thus designed may be obtained from given curves.
W69-02092

STORM-WATER CONTROL BY SIPHON SPILLWAYS AT EARLSWOOD SEWAGE WORKS, REIGATE,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02095

TESTING AND CALIBRATION OF STORM OVERFLOW CONTROL PIPES,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02096

TESTS ON A MODEL STILLING POND WITH SIPHON OVERFLOW,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02097

THE DESIGN AND EFFICIENCY OF STO WATER OVERFLOWS IN COMBIN SEWERAGE SYSTEMS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02102

PRACTICAL DESIGN OF STORM SEWA OVERFLOWS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02107

STORM-WATER OVERFLOWS: THE OPE TION AND DESIGN OF A STILLING POND,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02113

THE TREATMENT OF STORM SEWAGE,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02116

PROBLEM OF DESIGN OF INTERCEPT DEVICES WITH OVERFLOW WEIRS IN C BINED SEWER SYSTEMS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02117

HOW TO PLACE STORM SPILLWAY IN C BINED STORM AND SANITARY SE SYSTEM,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02118

POLLUTION CONTROL FOR STORM WAT AND COMBINED SEWER OVERFLOWS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02127

TROUBLE-FREE COMBINED SEWER SYSTEMS,
L. B. Escritt.
Survr, Vol 113, p 603, July 17, 1954.

Descriptors: Sewers, Pipes, *Storm ru *Velocity, Design.
Identifiers: *Combined sewers, *Capacity.

The author presents both the valid and 'fallac arguments for the preference of separate over bined sewerage systems. He repudiates the commonly given reasons for not using comb system; that is, that the large size pipes nece for the storm flow will be silted during dry we flow and if the gradient is increased to bring th weather flow to self-cleansing standards, exce depth will result. He points out 'that, while inc of diameter above that required for the flow usually reduce velocity, this reduction is very indeed, so that in the majority of instances a bined sewer has a satisfactory self-clea gradient if it is laid to the same gradient as wou adopted for the soil sewer if the system were made separate.' An example is given.
W69-02128

THE ENGINEERING PROBLEM OF BAL ING RATE OF FLOW AND STRENGTH SEWAGE,
L. B. Escritt.
Survr, Vol 104, p 221, 1945.

Descriptors: Design, *Weirs, *Sewage treat *Storm runoff.
Identifiers: *Storage tanks.

e design of weirs for separating storm water to given partial treatment is discussed. Discussed sign of storm water tanks having a 6-hour dry ather flow capacity.
59-02129

TERCEPTING SEWERS AND STORM ANDBY TANKS AT COLUMBUS, OHIO,
r primary bibliographic entry see Field 04A.
r abstract, see .
59-02132

OMBINED SYSTEM OF SEWERAGE WITH MITED RAW WATER INLET,
r primary bibliographic entry see Field 04A.
r abstract, see .
59-02133

VANTAGES AND PROBLEMS OF COM-NED SEWERAGE SYSTEMS,
r primary bibliographic entry see Field 04A.
r abstract, see .
59-02138

PARATE SYSTEMS-COMBINED SYSTEMS,
r primary bibliographic entry see Field 05D.
r abstract, see .
59-02139

IE TRUNK SEWER SYSTEM AND THE WAGE-TREATMENT PLANT OF THE WN OF UTRECHT. HISTORY AND TECHNI-L LAY-OUT,
r primary bibliographic entry see Field 05D.
r abstract, see .
59-02140

OGRESS REPORT-ASCE COMBINED WER SEPARATION PROJECT,
B. McPherson.
Eng, Vol 37, No 12, pp 61-2, Dec 1967.

scriptors: Pumping, *Design, *Equipment, locity, *Head loss, *Pressure conduits, Pipes, wage treatment.
ntifiers: *Combined sewers, *Sewer separation, sidential sewers.

neral concept for separation of combined verage systems involves pumping comminuted or ound sewage from individual buildings through ssure tubing to new and separate sanitary vage pressure conduits to treatment works; in-tigation of existing comminutor installations; earch to establish design criteria for minimum nsport velocities of sewage in pressure pipes; earch on head losses for pipe within combined ver; field investigations into feasibility of insert-; pressure tubing in existing building sewers; ting of contracts to develop household grinder-rage-pump units and hanger system for suspend-, pressure conduit in combined sewers.
59-02141

CE COMBINED SEWER SEPARATION PRO-CT PROGRESS,
B. McPherson.
nference Preprint 548, American Society of il Engineers National Meeting on Water sources Engineering, New York, NY, Oct 16-20, 57. 21 p, refs.

scriptors: Overflow, Velocity, Computer pro-ms.
ntifiers: *Sewer-within-sewer, *Combined vers, *Sewer separation.

er 100 persons, including staff members of vari-s subcontracting organizations, are actively stu-ng the 'sewer-within-sewer' concept of com-ed sewer separation, of pumping ground sewage m individual buildings through relatively small pressure tubing. Experimental and field data are being collected on grinding and pumping devices, installation of tubing in shallow trenches in place of non-walk-through sewers, types of tubing and connections, effect of installation on sewer surcharge capacity, transport velocity, and computer simulation, among others. About two dozen reports are expected, including some on concomitant solid waste disposal, and home-owner acceptability.
W69-02142

FEASIBILITY OF COMBINED SEWER SYSTEMS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02146

UNDERFLOW SEWERS FOR CHICAGO,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02151

A BRIEF HISTORY OF POLLUTION PROBLEMS AND POLLUTION CONTROL IN THE CITY OF LONDON, ONT,
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02157

A FLOODED-TUNNEL INTERCEPTOR SYSTEM FOR THE METROPOLITAN ST. LOUIS SEWER DISTRICT,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02158

ONE CITY'S APPROACH TO THE PROBLEM OF COMBINED SEWAGE OVERFLOWS,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02161

CORRECTING STORM-WATER INFILTRATION, TONAWANDA, NEW YORK,
Newell L. Nussbaumer.
Sewage and Industrial Wastes, Vol 28, pp 977-82, Aug 1956.

Descriptors: *Surface runoff, *Storm drains, Sewers, *Design, Construction, Construction costs.
Identifiers: *Storm sewers, *Sewer infiltration, Tonawanda (NY).

The article describes the layout and construction of the early sewers in Tonawanda, N.Y. Improper planning, poor construction, lack of storm sewers, and the diversion of surface water into the sanitary sewers caused flooding of the sanitary sewers during periods of precipitation. Increased tributary population intensified sewer problems. Several attempts were made to remedy the situation. In 1945 a comprehensive storm drain plan was developed to eliminate the excess water from the sanitary sewers. The types of storm sewers used, design criteria, construction details, and costs are outlined.
W69-02165

LOW PRESSURE AIR TEST FOR SANITARY SEWERS,
R. E. Ramseier.
ASCE Proc, J Sanit Eng Div, Vol 90, No SA2, pt 1, paper 3883, pp 1-29, April 1964.

Descriptors: *Sewers.
Identifiers: *Leak detection, Sewer infiltration.

Effect of moisture on permeability of vitrified clay sewer pipe and its effect on testing procedure; specifications for testing new pipe installations are suggested, and methods of computing time necessary to meet specifications for single size pipe and for combinations of various size pipes are given; field tests show that pipe without detectable failure will lose less than 0.003 cu ft of air/min/sq ft of internal pipe surface, and that any air loss exceeding 2 cu ft/min can be located.
W69-02167

EXPERIENCE IN USING LOW-PRESSURE AIR TEST FOR SANITARY SEWERS,
R. E. Ramseier, and G. C. Riek.
Water Poll Control Fed J, Vol 38, No 10, pp 1623-33, Oct 1966.

Descriptors: *Sewers.
Identifiers: *Leak detection, Sewer infiltration.

Low-pressure air test for sewer leakage has proved reliable, easy to use, and inexpensive; test, for which specifications have been developed, consists of introducing air into plugged section of pipe and measuring time needed for pressure to be reduced from 3.5 to 2.5 psi (0.24 to 0.18 kg/sq cm); nomograph is used to compute time acceptable according to specifications; increased wetness of pipe wall reduces air leakage through pipe-wall permeability, whereas increased pressure gradient between inside and outside of sewer increases leakage.
W69-02168

LOW PRESSURE AIR TEST FOR SANITARY SEWERS,
Roy E. Ramseier, and George C. Riek.
ASCE Proc, J Sanit Eng Div, Vol 90, No SA2, Pt 1, p 1, April 1964.

Descriptors: *Sewers, Maintenance.
Identifiers: *Leak detection.

Testing a sewer pipe for leakage by the use of air at pressures of approximately 3 psi can measure effectively the quality of the installation. New work can be tested by noting the time required for pressure in a closed section of the pipe to drop from 3.5 psi to 2.5 psi. Where significant leakage is present, it can be quantitatively determined by metering the amount of air required to maintain a pressure in the test section. The effect of moisture on the permeability of vitrified clay pipe and its effect on the testing procedure is determined. Specifications for testing new pipe installations, are suggested, and methods of computing time necessary to meet specifications for a single size pipe and for combinations of various size pipes are given. Field tests show that pipe without a detectable failure will lose less than 0.003 ft (3) of air per min per ft (2) of internal pipe surface and that any air loss exceeding 2.0 ft (3) per min can be located.
W69-02169

DEPOSITION IN A SANITARY SEWER,
C. H. Raths, and R. F. McCauley.
Water and Sewage Works, Vol 109, p 192, 1962.

Descriptors: *Deposition (Sediments), *Sewers, Design, Construction.
Identifiers: *Suspended solids.

An investigation into deposition in sanitary sewers is described. In each experiment, an 8-in pipe line was set at the required slope a uniform flow of sewage was produced and sand of known particle size was introduced at 8-ft intervals, in descending order of size. From the results which are shown in tables and graphs, an equation was developed to express the relation between the depth of flow, the largest size particle to pass successfully through the pipe, and the slope of the pipe. It was also found that solids suspended in the sewage apparently had little effect on deposition and that pipe joints were the principal influence in initiating deposition. It is concluded that in designing a sewer more emphasis should be placed on joints and construction techniques than on minimum pipe grades.
W69-02170

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REHABILITATION OF SANITARY SEWER LINES,
D. E. Rhodes.
Water Poll Control Fed J, Vol 38, No 2, pp 215-19, Feb 1966.

Descriptors: *Sewers, Construction, Sealants.
Identifiers: *Sewer infiltration, *Leak detection, *Polymers.

Excessive infiltration into sanitary sewer lines caused by faulty construction was problem in Montgomery County, Ohio; injection-type sealing with polymer-type grouting fluid applied within line seems to have reduced infiltration substantially; TV inspection located leaks and wastewater was diverted around plugged-off section; TV also was used for setting of packer over leaks.
W69-02171

SEWERS CAN BE REBUILT BY REMOTE CONTROL,
George Rutz.
Water Works and Wastes Eng, Vol 2, pp 42-43, Oct 1965.

Descriptors: *Sewers, *Sealants.
Identifiers: *Leak detection.

Sewer system leaks in approximately 3,000 ft of sewer were located by a closed-circuit television camera and then sealed with chemical 'gel' by a grouting machine. The units operated from within the sewer and were controlled remotely from the surface. The TV camera provided a view of the sealing process while it was being undertaken.
W69-02173

INFILTRATION IN SANITARY SEWERS,
I. W. Santry, Jr.
J Water Poll Control Fed, Vol 36, p 1256, Oct 1964.

Descriptors: Sewers, Construction.
Identifiers: *Sewer infiltration.

This paper points out the importance of infiltration in sanitary sewers. The degree of infiltration is influenced by such variables as climate, soil characteristics, ground water table position, materials of construction, vegetation, and the existence of illegal connections. In this investigation submergence tests were made on clay and concrete pipe using jute, cement, cold mastic, hot pour asphalt, rubber gasket, and PVC jointing materials. It was indicated that the newer joints have much less infiltration than the older ones. The author stresses the importance of building sewers with materials that will slow down infiltration, with joints that will stay tight and with bedding and backfill conditions that will prevent future movement of the pipe. Illegal connections should be eliminated.
W69-02174

STORM SEWER DESIGN BY THE INLET METHOD,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02179

USE OF 3m DIAM REINFORCED CONCRETE STORM SEWERS FOR WESTERN SIBERIAN METALLURGICAL PLANT, SOVIET UNION,
G. E. Korotkovskii, Yu M. Sedel'nitskii, and M. M. Tanakov.
Beton i Zhelezobeton, No 9, pp 8-12, Sept 1967.

Descriptors: *Design.
Identifiers: *Storm sewers, Russia.

Use of 3 m diam reinforced concrete storm sewers for Western Siberian Metallurgical Plant, Soviet Union; transverse reinforcement in 3 m sewers must be designed under high loads considering resistance of transverse and shearing force by concrete and reinforcement; each annular rod in tension zone should be fastened by ties; side earth pressure up to 20% of vertical load leads to increase of bearing capacity of sewer and should be considered during design; good agreement between theoretical and experimental values. In Russian.
W69-02180

LEAVES WON'T CLOG THIS CATCH BASIN,
R. E. Lapar.
Pub Works, Vol 95, No 3, pp 90-1, March 1964.

Descriptors: *Storm runoff, *Intakes, Design.
Identifiers: *Storm sewers, Urban drainage.

Storm sewer project, in Poughkeepsie, NY, required new design for street catch basins which incorporates depressed stream flow grate with extra wide curb opening; grating used has distinct advantage of offering tear-drop construction of cross-bars which minimizes tendency to retain leaves at surface and induce clogging.
W69-02182

HOW TO SIZE CONDUITS FOR STORM SEWERS,
Chesman A. Lee.
Chem Eng, Vol 67, No 20, pp 97-8, Oct 3, 1960.

Descriptors: Sewers, *Design, *Overflow.
Identifiers: *Storm sewers, *Manning formula.

A chemical plant must be supplied with storm as well as sanitary sewers. In general, sewers are designed to operate only partially full--quite different from the techniques of operating pipe lines full and under pressure. The Manning formula is discussed in considerable detail. A storm sewer may be designed to operate full and overflowing under the worst conditions. The fact that the sewer is under pressure need cause no concern since at times of heavy rains the soil is saturated and provides an opposing pressure. A problem and its step-by-step solution is given to illustrate methods used to provide design data.
W69-02184

STORM SEWER TUNNELING IN SANDSTONE,
K. K. McRae.
Pub Works, Vol 98, No 2, pp 110-11, Feb 1967.

Descriptors: *Tunnel construction.
Identifiers: *Storm sewers.

Features of tunneling in St. Paul and Minneapolis, Minn; normal stratigraphic sequence from surface down is-glacial drift (mixed silts, sands, clays, shales and boulders), Platteville Limestone, Glenwood Shale and St. Peter Sandstone; procedure in advancing tunnel was to direct h-p water at face to erode sandstone into sand slurry; mining water was obtained from dewatering wells and carried to machine in 8 in. pipe, passed through jet pumps, and directed at face through 1/4-in. diam nozzles mounted on hand lances; cutting pressure developed at pump was 400 psi; for tunnel lining modified type 3 grade Y concrete is used by concrete pumping machine; overall footage normally averages from 30 to 50 ft in 8-hr shift.
W69-02187

STORM SEWER SYSTEMS,
American Public Works Assoc Res Foundation.
Herbert G. Poertner.
State and Local Public Facility Needs and Financing Subcommittee on Economic Prog of the Joint Economic Committee - Congress of the US - Vol I, Public Facility Needs, pp 152-174, Dec 1966, 5 fig, 7 tab.

Descriptors: *Design.
Identifiers: *Storm sewers.

A broad study of storm sewer systems is presented. Characteristics, functions, and basic principles are discussed as well as standards of performance an design. The existing capital plant of storm sewers described. History, distribution, age and ownersh are all discussed and statistics are given. Cost charges and benefits are described. Trends capital outlay are discussed. Graphs show annu U. S. sewer pipe requirements for various si pipes. Expenditures by private land developers a public agencies are discussed. Sources of financi are outlined. Needs, prospective capital outla and sources of funds for 1966-75 are discussed.
W69-02190

CALCULATION OF RETENTION TANKS STORM-WATER SEWERS,
R. Randolf.
Wasserw-Wass Techn, Vol 9, p 148, 1959.

Descriptors: *Storm runoff, Drainage systems.
Identifiers: *Capacity, *Storage tanks, *Calcul tions.

The author discusses, with practical examples, t calculation of size of retention tanks on sto water drainage systems.
W69-02191

SPLIT LEVEL DESIGN FOR SEWER SEPAR TION,
W. G. Ridge.
Pub Works, Vol 97, No 11, p 97, Nov 1966.

Descriptors: *Sewers, *Construction, *Tunne *Storm runoff.
Identifiers: *Storm sewers, *Sewer separation.

Installation of sanitary sewers at invert of pre ously used combined sewer system; four cuts w made into 102-in. sewer and 10 to 12-ft long cor gated steel pipe sections were lowered with sett into position by fork-lift truck working ins sewer; sanitary sewer was of elliptical section; af placement, corrugated pipe was grouted w concrete to provide smooth flow for storm wa corrugated sanitary sewage pipe has been handl average flow of 25 million gpd, and storm wa capacity in modified tunnel is 500 cfs.
W69-02192

THE APPLICATION OF STORAGE CAPACI TO THE DESIGN OF SEWERS,
E. J. Sarginson.
Survr, Vol 119, p 215, 1960.

Descriptors: *Design, *Hydrographs.
Identifiers: *Storm sewers, *Capacity, Calcu tions.

The author shows how calculations involving storage capacity of circular sewers can be appl to reduce the size of the conventional storm-wa sewer, dealing particularly with the effect of shape of the hydrograph of flow into the pipe the rate of flow out of the pipe. It is suggested t reduction of pipe diameter to less than conv tional size should be confined to the lower la parts of a sewerage system.
W69-02194

STORM SEWER DESIGN FACTORS,
C. S. Seabrook.
Amer City, Vol 79, p 76, July 1964.

Descriptors: *Design, Discharge (Wat Drainage, *Flow measurement, *Rainfall inten *Runoff, *Intakes.
Identifiers: *Storm sewers, *Urban drainage.

An approach to the determination of de discharges for storm sewers in Puyallup, Wash discussed, wherein the runoff coefficient to used, and the actual contributing area within given drainage area is determined by actual f measurements to a curb inlet, with the resul flow being related to recorded rainfall intensi

Results of the experiments revealed justification for considering only the street rights of way as the contributing drainage area, and the assignment of a 0.9 runoff coefficient to this area, for purposes of design discharge calculations. Such examination of actual runoff conditions, as opposed to the arbitrary selection of a runoff coefficient times a total contributing drainage area, is reported to have saved the city some 20 per cent on a million dollar storm sewer project.
W69-02195

FUNDAMENTALS OF SEWER DESIGN,
W. O. Seppa.
Hydrocarbon Processing and Petroleum Refiner, Vol 43, No 10, pp 171-6, Oct 1964.

Descriptors: *Design, *Sewers.
Identifiers: *Storm sewers.

Four basic sewer systems used in typical hydrocarbon processing plants are oily water sewer, acid (chemical) sewer, storm water sewer and sanitary sewer; design and operation of each type.
W69-02196

SIMPLIFIED SEWER DESIGN,
R. B. Steytler.
Pub Works, Vol 91, p 102, June 1960.

Descriptors: *Sewers, *Design, Drainage systems, Rainfall intensity.
Identifiers: *Storm sewers, *Capacity, *Calculations, Erie (Pa.), *Urban drainage.

This article points out the necessity for revamping and extending the sewer system of the City of Erie, Pennsylvania, due to the growth in population and expansion of the area served by the system in recent years. The earlier designing did not take into consideration the future potential of the drainage areas, a situation which is typical in a number of communities. A simplified sewer design method was developed for use in extending and modifying the storm and sanitary sewer systems in the city which, according to the author, has proved effective and time saving both in original design and for checking of the existing system. The method consists of equating area to quantity of both sanitary and storm flow and superimposing the information on any one of a number of sewer design charts available. In this case a diagram based on Kutter's formula (n = 0.013) was selected. Basic sewer design principles are discussed together with development and adaptation of this design method. Drainage areas for both sanitary and storm drainage are plotted on the sewer design chart opposite the corresponding quantities of sewer flow. The sanitary portion of the chart was designed strictly on a population basis, with a sufficient safety factor to lead to an over-design. The chart is designed for the minimum size storm sewers considered economically safe in the City of Erie and a different runoff coefficient may be necessary in the application of the method in other areas. A design chart (based on Kutter's formula n = 0.013) is presented and the use of this method is illustrated and the procedures followed in applying the method are described. The chart is based on an average condition in Erie but its use in another area would possibly require an entirely different set of figures due to local design considerations. It is pointed out that, while the calculations and intentions of the sewer design chart is to over-design, it is still necessary for the final design to be checked to determine if the area under consideration is similar to that for which the chart was developed and includes all the potential drainage basin. A chart showing a rainfall intensity curve used for storm sewer design in Erie is also presented.
W69-02198

PROGRESS TO DATE AND CURRENT WORKS AT GLENROTHES NEW TOWN,
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02199

DRAIN THAT GREW AND GREW,
G. B. Wilkes, and J. R. Beilby.
Can Mun Utilities, Vol 103, No 4, pp 15-17, April 1965.

Descriptors: *Storm drains, Outlets, *Velocity, *Spillways.
Identifiers: *Storm sewers.

Features of Wilson Heights-Spadina Expressway storm trunk drain, Toronto, Ont; length of line selected is approximately 13,000 ft, and difference in elevation between invert of sewer at interchange and Don River outfall is approximately 136 ft; grade of sewer was chosen at 0.45% to keep maximum velocities below erosion velocity; with this grade, sewer was constructed from 34 to 80 ft below ground level until it interrupted gully which ran back in from river; feasibility of carrying water in open channel via gully with small spillways to dissipate energy was ascertained.
W69-02206

SOIL AND WATER PROBLEMS ON BUILDING SITES,
D. A. Williams.
Pub Works, Jan 1961.

Descriptors: *Land use, *Construction, *Water pollution, Outlets, Recreation facilities, *Stilling basins.
Identifiers: *Storm sewers.

Areas under construction such as new suburbs where all vegetation is stripped off and natural water courses are disturbed with streets, buildings, etc. are creating erosion problems with siltation of rivers and lakes. Even areas designed with storm sewers experience this problem because of the time lapse to get cover, lawn, etc. to grow. A study was made at a 8,200 acre undeveloped area outside Memphis, Tennessee, that is scheduled for development and the engineers recommended the constructing of 44 detention basins to be built at a cost of $1,400,000 instead of storm sewers. Basins to be designed to retain 60% of a 6-hour rainfall of 100-yr occurrence. The outlets would empty the basins in 24 hours. The larger detention sites could become green acres for parks and recreational use. Smaller basins or dry basins could be landscaped in with development.
W69-02207

GRAPHIC STORM SEWER DESIGN,
G. E. Zoellner.
Water and Sewage Works, Vol 109, p 447, Dec 1962.

Descriptors: *Design, Storm runoff, Overflow, *Rainfall intensity, Weirs.
Identifiers: Calculations, *Storm sewers, Storage tanks.

The exorbitant costs of storm sewer systems require the decision as to the degree of protection to be provided against property damage, nuisance, and inconvenience from surcharged sewers. The exact determination of the permissible frequency is not possible with the presently used methods, e.g., empirical formula and Rational Method. The Graphic Method, as used in Germany for 50 years, makes it possible to determine exactly the runoff for any frequency of surcharging, and this runoff is based on the most critical rainfall for each sewer stretch with regard to the relationship of rainfall intensity to rainfall duration. The Graphic Method permits analysis of storm water reservoirs and calculation of excess flows that are diverted over a weir as the rate of flow with respect to the time is given. The illustrated example shows that the storm sewer system designed with the Rational Method based on a 5-year storm frequency and 15 min. time of concentration will actually surcharge once a year.
W69-02208

SOME PROBLEMS IN THE HYDRAULIC DESIGN OF SMALLER TREATMENT WORKS,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02228

NO STORM-WATER BYPASS,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02229

TURKEY CREEK SEWAGE PUMPING STATION,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02232

EMERGENCY ALUM TREATMENT OF OPEN RESERVOIRS,
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02234

MAD RIVER, HUMBOLDT AND TRINITY COUNTIES, CALIFORNIA.
Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 359, 330 p, 1968. 1 plate, 4 append, 1 attach.

Descriptors: *Multiple-purpose projects, *Flood control, *Recreation, *Water supply, *California, Rockfill dams, Reservoirs.
Identifiers: *Mad River, Butler Valley, Humboldt County, Trinity County.

Flooding, recreational needs, and water-supply problems of Mad River, north of San Francisco, California, were surveyed and a multiple-purpose dam and reservoir project is recommended. By constructing a rockfill dam 350 ft high, 1,850 ft long, creating a reservoir of 460,000 acre-ft capacity in Butler Valley, practically all the flood damage (potentially $438,000 per year) can be eliminated, a water yield of 160,000 acre-ft per year could be developed, and an estimated 2 million visitors per year could use the reservoir for recreation. The initial cost is estimated to be $35,100,000 and the benefit-cost ratio is 1.7 to 1. (Knapp-USGS)
W69-02280

LOWER CHARLES RIVER WATERSHED, MASSACHUSETTS.
Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 370, 81 p, 1968. 2 plate, 2 map, 6 photo, 5 tab, 1 append, 1 attach.

Descriptors: *Dams, *Flow control, *Outlet works, *Sluices, Impoundments, Cost-benefit ratio, Reservoirs, River regulation, Recreation.
Identifiers: Boston (Massachusetts), Charles River Dam.

The ability of the sluice gates of the Charles River Dam in Boston, Massachusetts, to pass increased runoff resulting from increased urbanization was investigated and found inadequate. The dam, which impounds 8.6 river miles, was constructed to prevent tidal flooding of lowlands, sewers, and drains and to create a recreational pool over previously unsightly tidal flats. Damages in August 1955 caused by inability of the sluice gates to pass a record flood amounted to $5.5 million, and if repeated today would cost $12.4 million. The dam cannot economically be modified. It is recommended that a new dam be built with a pumping station, 3 locks, a highway viaduct, and appurtenant structures. First cost is $26,500,000, annual cost is $184,000, and benefit-cost ratio is 1.9 to 1. (Knapp-USGS)
W69-02281

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PAPILLION CREEK AND TRIBUTARIES, NEBRASKA.
Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 349, 174 p, 1968. 2 fig, 17 tab, 2 append, 1 attach.

Descriptors: *Multiple-purpose projects, *Flood control, *Recreation, *Water quality, *Dams, Nebraska.
Identifiers: Omaha, Papillion Creek.

A multiple-purpose flood control, water quality control, and recreational project is proposed for Papillion Creek, Omaha, Nebraska. The project includes 21 dams and reservoirs, in 8 of which water-quality control provisions would be included. Estimated cost is $26,800,000. Hydroelectric power and navigation development are infeasible. The benefit-cost ratio of the 21 reservoirs as proposed is 2.0 to 1. (Knapp-USGS)
W69-02282

BEAR CREEK BASIN, SOUTH PLATTE RIVER AND TRIBUTARIES, COLORADO, WYOMING, AND NEBRASKA.
Corps of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, Senate Doc No 87, 175 p, 1968. 1 map, 11 tab, 4 append, 1 attach.

Descriptors: *Flood control, *Recreation, *Dams, Multiple-purpose projects, Colorado.
Identifiers: Denver, Morrison, Bear Creek.

To control flooding of Bear Creek, a left-bank tributary of the South Platte River in metropolitan Denver, Colorado, a multiple-purpose flood control and recreational reservoir is proposed. The recreational pool would have an area of 130 acres. The estimated cost is $20,851,000. Estimated annual flood damage potential is $1,103,000. Estimated annual flood protection benefit is $930,000. (Knapp-USGS)
W69-02283

COLORADO RIVER AND TRIBUTARIES, TEXAS, COVERING MOUTH OF COLORADO RIVER.
Corps. of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, Senate Doc No 102, 85 p, 1968. 1 plate, 6 tab, 1 append.

Descriptors: *Multiple-purpose projects, *Flood control, *Navigation, *Channels, Canals, Jetties, Diversion, Bank stabilization, Levees, Texas.
Identifiers: Turning basins, Colorado River (Texas).

A multiple purpose project is recommended to improve navigation and flood control at the mouth of the Colorado River, Texas. It was found that the best plan would provide for diversion of the Colorado River into Matagorda Bay and conversion of the existing river channel into a navigational channel with jetties at the Gulf shore line and a turning basin at the town of Matagorda. Specific measures are provided to satisfy needs for a navigable channel from Matagorda, Texas, to the Gulf of Mexico, and to develop the recreation potential of the area. The improvements will also realize benefits from reduction of flood damages to existing developments along the Colorado River channel below the point of diversion and from increase in commercial seafood catch. The estimated first cost to the United States for all recommended new work is $11,554,000, of which $128,000 would be reimbursed by local interests. The estimated increase in annual maintenance cost for the project is $166,000, including $24,000 non-Federal annual maintenance cost. The annual charges of the recommended project are estimated at $660,000 and the annual benefits are estimated at $837,000. The ratio of annual benefits to cost is 1.3.
W69-02292

WILD RICE RIVER, MINNESOTA.
Corps. of Engineers, Washington, D. C.

U S 90th Convr, 2d Sess, House Doc No 366, 229 p, 1968. 3 plate, 16 tab, 1 attach, 2 append.

Descriptors: *Multiple-purpose projects, *Flood control, *Recreation, *Dams, Minnesota.
Identifiers: Wild Rice River, Marsh River.

A multiple-purpose project is proposed to alleviate recurrent flooding which causes serious damage to agricultural land along the Wild Rice and Marsh Rivers, Minnesota, and to increase recreational facilities in the area. The 1965 flood damages totalled $840,000. Recreational needs are urgent. A reservoir is recommended on the Wild Rice River above Twin Valley, Minn., at an estimated cost of $8,155,000. The benefit-cost ratio is estimated to be 1.5 to 1. (Knapp-USGS)
W69-02297

PECAN BAYOU, TEXAS.
Corps. of Engineers, Washington, D. C.

U S 90th Congr, 2d Sess, House Doc No 350, 326 p, 1968. 5 fig, 2 plate, 6 tab, 4 append, 1 attach.

Descriptors: *Multiple-purpose projects, *Water supply, *Flood control, *Recreation, *Dams, Texas, Channel improvement.
Identifiers: Pecan Bayou, Brownwood, Coleman.

Study of the dam and spillway at Lake Brownwood, Texas, shows that the structures are in urgent need of repair and replacement to prevent dam failure and catastrophic flooding of the city of Brownwood. In addition, present flood and water-supply problems exist. It is recommended that the present Lake Brownwood dam and spillway be reconstructed, channel improvements be made along Pecan Bayou, Adams Branch, and Willis Creek in Brownwood, and that Pecan Bayou and Coleman reservoirs be constructed upstream from Lake Brownwood. The previously authorized enlargement of Lake Brownwood is considered uneconomic and it is recommended that it be deauthorized. The estimated improvement cost is $33,691,000. (Knapp-USGS)
W69-02298

8C. Hydraulic Machinery

ONE WAY TO BYPASS A LARGE SEWER,
Charles A. Manganaro.
Water Works and Wastes Eng, Vol 1, pp 46-47, July 1964.

Descriptors: *Automatic control, Instrumentation, *Overflow, Design.
Identifiers: *Sewer infiltration.

A unique plug valve designed to permit automatic bypass of an 84 in. trunk sewer has been installed by the Bergen County Sewer Authority in New Jersey. An overflow chamber was constructed over the 84 in. line just before the sewer crosses the Hackensack River. The valve consists of a large circular plate with a continuous circular neoprene gasket riveted to the underside to prevent infiltration of water due to tidal conditions and also to seal against odors when not operating. The cylinder, mounted on the underside of the plate, acts as a buoyant force and the lift is counteracted by the addition of lead ballast into the cylinder. The valve is designed to lift when the gradient of the sewer is 2 in. above the top of the overflow chamber. Side guides set around the cylinder keep the valve centered. Valve stops are mounted above the overflow chamber to prevent the valve from being lifted out of the opening. The complete valve, weighing about 4,000 lb, can be lifted for inspection by means of jacks.
W69-02105

MAINTENANCE OF STORM FLOW REGU TORS,
Max B. Phillips.
Sewage and Industrial Wastes, Vol 31, No 7, p July 1959.

Descriptors: *Storm runoff, *Instrumenta *Flow control, Maintenance.

A survey was made of cities in the State of Oh to the use and performance of regulators. T per cent of the cities reported that regulators a major problem and a break-down of the kin malfunctioning is given. An outline of a wor program of regulator inspection and mainten is developed.
W69-02108

WASTE TREATMENT PLANT MODIFIED INCREASED SOLIDS LOADING,
For primary bibliographic entry see Field 05D. For abstract, see .
W69-02110

PROGRESS REPORT-ASCE COMBI SEWER SEPARATION PROJECT,
For primary bibliographic entry see Field 08A For abstract, see .
W69-02141

ASCE COMBINED SEWER SEPARATION JECT PROGRESS,
For primary bibliographic entry see Field 08A For abstract, see .
W69-02142

THE TRUNK SEWER SYSTEM AND SEWAGE-TREATMENT PLANT OF TOWN OF UTRECHT. II. STORAGE CA TY OF SEWERS AND PUMP REGIME,
For primary bibliographic entry see Field 05D For abstract, see .
W69-02162

OIL RETENTION IN STORM-SEWAGE P ING STATIONS AND STORM-SEV TANKS,
For primary bibliographic entry see Field 05D For abstract, see .
W69-02181

ARE PROTECTED STORM WATER OUT DANGEROUS TO STREAMS,
For primary bibliographic entry see Field 05E For abstract, see .
W69-02189

8D. Soil Mechanics

EFFECT OF USING CONTINUALLY MERGED DRAINS ON DRAIN SPACINGS.
For primary bibliographic entry see Field 04A For abstract, see .
W69-02205

AN INVESTIGATION INTO INFILTRA AND INTERCEPTION RATES DURING S RAINFALLS AND THEIR APPLICATIO FLOOD PREDICTION,
Allan O. Lambert.
J Instn of Water Engrs, Vol 21, No 6, pp 5 Aug 1967.

Descriptors: *Rainfall-runoff relatio *Hydrographs, *Runoff forecasting, forecasting.

An investigation was made into the relat between combined infiltration and inter rates during periods of heavy rainfall and representing various soil-moisture conditio

rometric data were obtained from a catchment a of 18.5 sq miles in South Lancashire. A flood lysis method capable of predicting direct run- in hourly intervals was developed. This method, ıbined with the use of unit hydrographs, pro- ed accurate predictions of both the magnitude temporal distribution of the river hydrographs. 9-02242

. Materials

W PRESSURE AIR TEST FOR SANITARY VERS,
primary bibliographic entry see Field 08A.
abstract, see .
9-02167

PERIENCE IN USING LOW-PRESSURE AIR ST FOR SANITARY SEWERS,
primary bibliographic entry see Field 08A.
abstract, see .
9-02168

W PRESSURE AIR TEST FOR SANITARY VERS,
primary bibliographic entry see Field 08A.
abstract, see .
9-02169

HABILITATION OF SANITARY SEWER ES,
primary bibliographic entry see Field 08A.
abstract, see .
9-02171

ILTRATION IN SANITARY SEWERS,
primary bibliographic entry see Field 08A.
abstract, see .
9-02174

. MANPOWER, GRANTS AND FACILITIES

. Education (Extramural)

THE USE AND INTERPRETATION OF HYDROLOGIC DATA.
United Nations Economic Commission for Asia and the Far East.

ECAFE Water Resources Ser No 34, 195 p, 1968. 158 fig, 90 tab.

Descriptors: *Training, *Professional personnel, *Hydrology, *Statistics, *Data processing, Forecasting, Infiltration, Runoff, Precipitation (Atmospheric), Streamflow, Water yield, Evapotranspiration, Groundwater.
Identifiers: ECAFE (United Nations), Training seminar.

A training seminar in hydrology conducted by the United Nations contains lectures on methods of collecting hydrological data, basic statistics, predictive methods, application of statistical methods to hydrologic data reduction, and selected examples of analytical techniques. The countries for which the lecture series was given listed assessment of mean stream yield and minimum flows, estimation of flood magnitude, assessment of evaporation and evapotranspiration, infiltration, and estimation of safe groundwater yields as their major training needs. These needs require training in statistics as well as in the elements of hydrology. The experience of the consultants is valuable in training new hydrologists, and an attempt was made to include as many results of their field experience as possible. (Knapp-USGS)
W69-02334

9D. Grants, Contracts, AND Research Act Allotments

COMBINED SEWER STUDY,
Herbert G. Poertner.
APWA Reporter, p 6, June 1967.

Descriptors: *Surveys.
Identifiers: *Combined sewers.

A brief announcement of an FWPC contract to the APWA Research Foundation concerned with combined sewers is presented. On-site personal interviews will provide detailed information on the combined sewer systems of approximately 900 communities. Officials of all cities of over 25,000 population plus a maximum of 30% of those in smaller communities will be interviewed.
W69-02152

STATUS OF WATER RESEARCH IN THE UNITED STATES,
Department of Interior, Washington, D. C. Office of Water Resources Research.
Roland R. Renne.
Journal of the American Water Works, Vol. 60, No. 7, July 1968, p 749-54.

Descriptors: Water pollution, Water supply, Water demand, *Research and development, Water treatment, Financing, Expenditures, State governments, Local governmets, *Water Resources Planning Act, *Water Resources Research Act.
Identifiers: Budget, *Water research goals, Basic research, Water Quality Act of 1965.

There are six major types of water problems: pollution, inadequate supply, uneven distribution, floods, variability of supply and demand, and water treatment. The main problem is not a shortage of water, but a shortage of ideas, technology, and management abilities to utilize the available supplies more effectively. To solve this problem, new research, well funded and organized, must be undertaken. New legislation by Congress, the Water Resource Research Act of 1964, the Water Resource Planning Act of 1965, the Water Quality Act of 1965, and the Clean Water Restoration Act of 1966, has contributed to advancements in research planning and development. Seven goals are outlined which should direct the basic research undertaken. Present expenditures in federal research efforts are reviewed and 'short fall areas' where investment in research has not been sufficient are discussed. Eight possible approaches to the solution of the water problem: (1) purification or treatment of wastes to make the water usable; (2) reuse treatment after each major use; (3) restricted or curtailed use through metering or higher charges; (4) use classifications for water quality; (5) improved management of watersheds to increase water recharge; (6) desalting; (7) weather modification; and (8) importation from other areas. (Gargola-Chicago)
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 2, NUMBER 7
APRIL 1, 1969

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NEW SERIES

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is $22.00 (domestic), $27.50 (foreign); single copy price is $3.00.

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SELECTED
WATER RESOURCES ABSTRACTS

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Office of Water Resources Research, U.S. Department of the Interior

VOLUME 2, NUMBER 7
APRIL 1, 1969

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States--now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

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To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions AND Suspensions

HERMOSPHYSICAL PROPERTIES OF ALINE WATER,
lonsanto Research Corp. Everett, Mass.
lexander Korosi, and B. M. Fabuss.
ffice of Saline Water Research and Development rogress Report No. 363, Sept., 1968. 53 p. OSW-4-01-0001-466.

escriptors: *Water properties, *Aqueous solu-ons, *Saline water, *Viscosity, *Thermal conduc-vity, Physical properties, Viscometers, Elec-olytes, Sodium sulfate, Magnesium compounds, otassium compounds.
lentifiers: *Transport properties, *Electrolyte ixtures, Othmers rule, Magnesium sulfate, Potas-um chloride.

xperimental viscosity measurements were made n water and electrolyte solutions containing one two of the major sea water components, NaCl, Cl, Na2SO4 and MgSO4, dissolved in water. The scosity of synthetic calcium-free sea water and its oncentrates was also determined. The measure-ents covered the range from 25 degrees to 150 egrees C. The experimental results on binary solu-ons were correlated using Othmer's rule, which tablishes a linear relationship between the garithm of viscosity of an aqueous solution and at of water at the same temperature. The correla-on reproduced the measured data with an overall recision of 0.4 - 0.5%. Literature data were com-ared with the correlation. The same correlation as used in evaluating the measurements on terna- solutions. Here the additivity of Othmer con-ants was assumed and verified. Thermal conduc-ity measurements were made on water, NaCl and a water solutions in the temperature range of 25 - 50 degrees C. The molality of NaCl solutions was 7 and 3.5, and the solute concentration in the nthetic sea water corresponded to the ionic rength value of normal and three-fold concen-ated sea water. A transient rather than a steady ate method was used for the measurements. The perimental measurements on these liquids were rrelated as functions of temperature and the data ere compared with literature information. (Scott-SW)
769-02784

APOR PRESSURE LOWERING OF AQUEOUS OLUTIONS AT ELEVATED TEMPERATURES,
Vestinghouse Research Labs., Pittsburgh, Pa.
. T. Lindsay, and C. T. Liu.
ffice of Saline Water Research and Development rogress Report No. 347, May, 1968. 235 p. OSW-4-01-0001-407.

escriptors: *Sodium chloride, *Vapor pressure, Thermodynamics, *Aqueous, *Solutions, *Water ructure, Sea water, Heavy water, Sodium sulfate, ntropy, Enthalpy, Free energy, Physicochemical operties, Electrolytes, Ions.
entifiers: *Boiling point elevation, Lithium com-ounds, Cesium compounds, Activity, Salt solu-ons, Excess properties, Osmotic coefficients.

n experimental method was developed for deter-ining osmotic coefficients of aqueous solutions by apor-pressure lowering measurements at 125 egrees C to 300 degrees C. Measurements were ade on sodium chloride solutions to as low as 0.1 olal. Activity coefficients were obtained for the lt, and excess thermodynamic functions were cal-lated for both components. The partial excess ntropy of the salt was found to have a primary in-uence on the thermodynamics of solutions at high mperatures. Results were interpreted in terms of n association and the effects of ions on the struc-re of water. Measurements were also made on lutions of lithium chloride, cesium chloride, sodi-n sulfate, magnesium sulfate and a mixture simu-ting a sea water concentrate. Association and hydrolysis reactions were found to be important at high temperatures in solutions of higher-valence-type salts and solutions of mixtures containing these salts. The vapor pressure of heavy water was redetermined to 300 degrees C. An improved esti-mate was made for the critical pressure of heavy water. The differences between solutions of NaCl in H2O and D2O were investigated. (Scott-OSW)
W69-02785

02. WATER CYCLE

2A. General

URBAN HYDROLOGIC RELATIONSHIPS,
Maine Univ., Orono.
W. Viessman, Jr., W. R. Keating, and K. N. Srinivasa.
Maine Water Resources Center, Publication No 6, 18 pages, Dec 1968. OWRR Project A-010-Me.

Descriptors: *Hydrology, *Unit hydrographs, Routing, Infiltration.
Identifiers: *Inlet hydrographs, Hydrologic simulation.

This research project was conducted to determine: (1) the degree to which a simple linear reservoir model could reconstitute hydrographs of runoff from urbanized inlet areas; (2) the applicability of the inlet hydrograph model combined with a linear channel model and additional attenuation features for computing runoff from a large composite urban drainage area; and (3) the nature of a general loss function for use in urban runoff studies. Objectives (1) and (2) have been satisfied. Objective (3) has been partially met but requires further study which will depend on data not available at the completion of this report. (Author)
W69-02408

GROUND-WATER FLOW RELATED TO STREAMFLOW AND WATER QUALITY,
Geological Survey, St. Paul, Minn.
W. A. Van Voast, and R. P. Novitzki.
Water Resour Res, Vol 4, No 4, pp 769-775, Aug 1968. 7 p, 4 fig, 11 ref.

Descriptors: *Groundwater flow, *Streamflow, *Water quality, Aquifers, Groundwater, Hydrology, Minnesota, Groundwater recharge, *Hydrogeology, Surface waters, Topography, Geology, *Groundwater geology.
Identifiers: Yellow Medicine River (Minn.), Geologic profiles.

A ground-water flow system in southwestern Minnesota illustrates water movement between geologic units and between the land surface and subsurface. Flow patterns indicate numerous zones of ground-water recharge and discharge controlled by topography, varying thicknesses of geologic units, variation in permeabilities, and the configuration of the basement rock surface. Variations in streamflow along a reach of the Yellow Medicine River agree with the subsurface flow system. Increases and decreases in runoff per square mile correspond to ground-water discharge and recharge zones. Ground-water quality variations between calcium sulfate waters typical of the Quaternary drift, and sodium chloride waters typical of the Cretaceous rocks are caused by mixing the 2 water types. Mixing zones agree with ground-water flow patterns along the hydrologic section. (USBR)
W69-02570

MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
Colorado State Univ., Fort Collins.
Robert A. Longenbaugh.
Proc Ser No 3, Symp Amer Water Resour Ass, San Francisco, Calif, pp 74-83, Nov 1967. 10 p, 7 fig, 8 ref.

Descriptors: *Groundwater geology, Groundwater, Groundwater flow, Groundwater recharge, Water resources, *Aquifers, Simulation, Computer programming, Hydrology, Deep wells, Atmospheric precipitation, Streams, Streamflow, Irrigated land, *Water table, Hydraulic conductivity, Finite differences, Pumping, *Recharge, Colorado, *Mathematical models.
Identifiers: Arkansas River Valley.

A generalized digital computer program simulates the conjunctive use of surface and ground water in a stream-aquifer system. The model was adapted to the 25-mi reach of the Arkansas River Valley between La Junta and Las Animas, Colo. Water table fluctuations in the aquifer, and water exchange between the river and aquifer were studied with time. Variables considered included: water applied within the area as irrigation; recharge due to precipitation; withdrawals from the aquifer by pumps and phreatophytes; and geologic parameters of permeability, storage coefficient, bedrock elevation, and initial amount of water in storage. A comprehensive hydrologic evaluation by the Geological Survey provided data used in verifying the model. The period from Oct 1, 1963, to Oct 1, 1964, was simulated, and experience with the model indicated that satisfactory verification was obtained. Modeling ground-water systems with digital computers provides flexibility, rapid analyses, and an economical approach. Using digital computer models for making administrative decisions and for optimizing water resources is expected. (USBR)
W69-02591

A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
Pennsylvania State Univ., University Park.
Harsha Desai, and David L. Raphael.
Proc Ser No 3, Symp Amer Water Resour Ass, San Francisco, Calif, pp 59-73, Nov 1967. 15 p, 5 fig, 4 tab, 5 ref.

Descriptors: *Watersheds (Basins), *Drainage basins, Hydrology, Runoff forecasting, Runoff coefficient, *Stochastic processes, Surface runoff, Runoff, Rainfall, Markov processes, Atmospheric precipitation, Routing, Hydrographs, Rainfall-runoff relationships, Impoundments, Mathematical models.
Identifiers: *Catchments, *Hydrologic models, *Stochastic models, Markov chain, Susquehanna River (Pa).

A study was conducted to develop a model for predicting watershed surface flow resulting from precipitation. This was to be achieved with more accuracy and simpler computations than was possible with conventional methods. The hydrologic phenomenon of surface flow due to rainfall was assumed to approach that of an absorbing Markov chain process with certain absorbing states in the body of the chain. Transfer coefficients were estimated as an average of various proportions for the total time period considered. Total rainfall and total surface flow attributed to this rainfall were estimated. The ratio of the resultant surface flow and rainfall responsible for this flow was the estimated average proportion of surface flow for the basin. Estimated flows were very close to actual flows except for the first 2 days of a 9-day period. The model gave the total response behavior of the system although it was not reported in detail. The objective of the study, to predict surface flow from an interconnected system of watersheds, was accomplished successfully; however, further refinement and development must be accomplished to make the model a useful hydrologic tool. (USBR)
W69-02592

THE OPTIMUM USE OF A GROUND-WATER AND SURFACE-WATER SYSTEM: A PARAMETRIC LINEAR PROGRAMMING APPROACH,
California Univ., Berkeley.
For primary bibliographic entry see Field 06A.
For abstract, see .

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W69-02619

SYNTHESIZING DAILY DISCHARGE FROM RAINFALL RECORDS,
Geological Survey, Carson City, Nev.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-02694

TRITIUM MEASUREMENTS IN NATURAL HAWAIIAN WATERS: INSTRUMENTATION,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02781

MATHEMATICAL SIMULATION OF SMALL WATERSHED HYDROLOGIC PHENOMENA,
Utah Water Research Lab., Logan.
V. V. Dhruva Narayana, and Jay M. Bagley.
Research Project Technical Report to Office of Water Resources Research, Department of Interior, December 1967, Washington D. C. 99 p, 26 fig, 37 ref. OWRR Project B-011-Utah.

Descriptors: *Surface runoff, *Mathematical simulation, Small watersheds, Hydrograph synthesis, Hydrographs, *Abstractions, Precipitation, Interception, Infiltration, Depression storage, Routing, Routing procedure, *Hydrologic process, Simulation, Dynamic system, Schematic diagrams, Watershed shape, Watershed size, Soil characteristics, Vegetative characteristics, Channel geometry.

In many hydrologic investigations concerning small watersheds, data and observations are totally inadequate to provide a basis for outflow hydrographs. Consequently, a variety of empirical approaches have been developed which have limited rational validity. Hydrograph synthesis offers a reasonable approach to predicting the outflow hydrograph characteristics. In order to synthesize a hyrograph, it is necessary to mathematically describe the physical behavior of the dynamic processes involved in the hydrologic phenomena. Hydrograph synthesis may be considered to comprise (a) hydrographs (actual or simulated) of precipitation, (b) hydrographs of abstractions such as interception, infiltration, and depressional storage, (c) routing or translating the net rainfall rate (rate of rainfall excess) in finite intervals of time and distances up to the outlet point. The complexities of this routing procedure are many, considering the variable factors such as the shape and size of watershed, soil and vegetative characteristics, nonuniform surface conditions, slopes, and channel geometry. This report is a review of the relationships developed for describing each hydrologic process from the design storm pattern to the final phase of the channel routing. Satisfactory simulation requires connecting all of these process descriptions in such a manner that they combine into a logical and compatible total dynamic system. Schematic diagrams are presented in the discussion and the various methods available for different stages of hydrograph synthesis are indicated.
W69-02798

APPLICATION OF AN ELECTRONIC ANALOG COMPUTER TO THE PROBLEMS OF RIVER BASIN HYDROLOGY,
Utah Water Research Lab., Logan.
John Paul Riley, and Duane G. Chadwick.
Research Project Technical Report to Office of Water Resources Research, Department of Interior, December 1967, Washington D. C. 199 p, 11 tab, 56 fig, 3 append, 63 ref. OWRR Project B-011-Utah.

Descriptors: *Hydrologic models, *Hydrologic simulation, *Simulation, *Electronic analog computer, Infiltration, Runoff, Rainfall, Precipitation, *Watershed studies, *Snowmelt, Evapotranspiration, *Hydrology, *Hydrologic research, *Water yields, *Water rousource planning and development, Experimental watersheds, Soil moisture, Semiarid watershed studies, Convective storms.

As demands upon available water supplies increase, there is an accompanying increase in the need to assess the downstream consequences resulting from changes at specific locations within a hydrologic system. This problem was approached by electronic analog simulation of the hydrologic system. The complexity of a hydrologic model depends to a large extent upon the magnitude of the time and spatial increments utilized in the model. The increment size selected depends upon the types of problems to be solved. Three models are described, and in each succeeding model the definition in terms of time and/or space is improved. While the improved model is capable of solving the same heirarchy of hydrologic problems as its predecessor, it is also capable of solving many additional problems which require a higher degree of definition. Preliminary verification studies for both the second and third models have shown close agreement between observed and computed discharge hydrographs from prototype basins.
W69-02799

2B. Precipitation

INSTRUMENTATION AND OPERATION OF METEOROLOGICAL AND STREAM GAGING STATIONS ON MAYNARD CREEK,
Montana State Univ., Bozeman. Joint Water Resources Research Center.
Theodore T. Williams.
Montana University Joint Water Resources Research Center Report No. 7, February 1967. 9 p, 8 fig, 16 tab, 1 append. OWRR Project A-006-Mont.

Descriptors: *Weather data, *Watersheds (Basins), Montana, Raingages, Venturi flumes, Thermometers, Hygrometry.

Five meteorological stations for the measurement of precipitation, air temperature and humidity, and three stream gaging stations were established on Maynard Creek within the Bridger Hydro-Meteorological Research Area northeast of Bozeman, Montana in 1965. Operation of three of the meteorological stations and the stream gaging stations began in August 1965, and was continuing in February 1967. Precipitation measurements were made in Belfort recording weighing raingages; temperature and humidity were measured by Belfort recording hygro-thermographs; stream discharge was measured in Parshall flumes equipped with Leupold and Stevens Type F recorders. Summaries of data collected in 1965 and 1966 were included. (Author)
W69-02485

2C. Snow, Ice, AND Frost

HYDROLOGICAL BUDGET STUDIES ON GEOPHYSICALLY TEMERATE GLACIERS,
Massey Univ., Palmerston North (New Zealand).
R. D. Thompson.
J of Hydrol (New Zealand), Vol 7, No 1, pp 13-23, 1968. 11 p, 3 fig, 2 tab.

Descriptors: *Hydrologic budget, *Glaciers, Ablation, Firn, International Hydrological Decade, Methodology.
Identifiers: *Glacial hydrology, *New Zealand, *Orwell Glacier, Maritime-polar environment.

The hydrological budget in a maritime-polar glacial environment is studied to contribute to the clarification of the critical relationship between subantarctic glacial hydrology and meteorological parameters. The hydrological budget of the Orwell Glacier at Signy Island in British Antarctic Territory was measured with special reference to the changes in glacier mass associated with wate movement onto, within and from the glacier. The influence of meteorological parameters on the gla cial hydrology, englacial temperature structures and surface velocity patterns are areas of specia research. The meteorological-hydrological rela tionships on a macro- and microscopic scale in volved the evaluation of glacier fluctuations i terms of available and easily measured synopti parameters. The micro-investigations were con cerned with the energy-transfer processes and th actual energy change at the glacier surface. (L laverias-USGS)
W69-02691

2D. Evaporation and Transpiration

EVAPOTRANSPIRATION--A REVIEW O LITERATURE WITH PARTICULAR ATTEN TION TO THE ROLE OF ADVECTED ENERG AND LYSIMETER STUDY OF EVAPOTRANS PIRATION,
Nebraska Univ., Lincoln.
N. J. Rosenberg.
Horticulture Progress Report 53, Agricultural E periment Station, University of Nebraska. 111 p OWRR Project A-001-Neb.

Descriptors: *Advection, Climatolog *Evapotranspiration, Estimating equation *Lysimeters, *Energy balance.
Identifiers: *Literature review.

The scope of evaporation and drought in the Gre Plains is discussed and a historical review research in evapotranspiration is presented. T theory of aerodynamics, energy budget and empi cal approaches to estimation of evapotranspirati is discussed and evaluated. Literature related to t problem of advective energy sources unaccount for by the radiation balance is reviewed in deta Lysimetry methods and practices are reviewed permit the refinement of the use of precisi lysimeters in measuring evapotranspiration. A to of 225 references are appended. (Reed-Nebraska
W69-02486

WATER LEVEL FLUCTUATION EVAPOTRANSPIROMETERS,
Geological Survey, Phoenix, Ariz.
T. E. A. Van Hylckama.
Water Resour Res, Vol 4, No 4, pp 761-768, A 1968. 8 p, 7 fig, 24 ref.

Descriptors: *Fluctuation, Transpirati Southwest U. S., Groundwater, Evapotranspi tion, Diurnal, *Water level fluctuations, Bibliog phies, Water table, Bubbles, Barometric pressu Temperature, Plastics, Air, Soil moisture, Agric ture.
Identifiers: *Evapotranspirometers, Buckeye P ject (Ariz), Air bubbles.

Eleven plastic-lined evapotranspirometer ta were constructed near Buckeye, Ariz. Levels of artificially maintained ground water in these inst ments show distinct diurnal fluctuations. On b tanks or on vegetated tanks that are not transpir these fluctuations are highly correlated with d nal and semidiurnal atmospheric fluctuations. T possible reasons for such responses are that: (1) bubbles may exist in the saturated zone, or (2) flexibility of the plastic lining. The barometric e ciency is about 40%. On vegetated tanks that transpiring, the water level and barometric cu are out of phase, but if water levels are correc for atmospheric pressure fluctuations, a curve pears representing the hourly rate of water Results show that plastic-lined evapotranspiro ters, of which there are many in the southwest United States, may be capricious instruments yi ing data that should be handled with caut (USBR)
W69-02569

TRANSPIRATION AND THE STOMATA OF LEAVES,
Connecticut Agricultural Experiment Station, New Haven.
Paul E. Waggoner, and Israel Zelitch.
Sci, Vol 150, No 3702, pp 1413-1420, December 10, 1965. 8 p, 5 fig, 1 tab, 48 ref.

Descriptors: Plant physiology, *Transpiration, Stomata, *Leaves, Photosynthesis, *Transpiration control, Water vapor, Water loss, *Pores, Environmental effects, Turgidity, Inhibitors, Resistance, Temperature, Spraying.

Outlined in this article were the mechanism of stomatal opening and closing and the influence of stomatal apertures upon the diffusion of gas particularly the water vapor that escapes the moist leaf interior. These two areas were studied with respect to turgor and stomatal opening, environment, biochemical inhibitors, history of resistance studies, stomatal resistance and transpiration, leaf temperatures, photosynthesis and spraying to conserve water that would be lost to transpiration. The study of transpiration and the stomata of leaves is important in arid climates since water loss through leaf pores is controlled by pore size, which varies with environment and chemical sprays. (Blecker-Arizona)
W69-02746

LEAF TEMPERATURES OF DESERT PLANTS,
Missouri Botanical Garden, St. Louis.
David M. Gates, Ronald Alderfer, and Elwynn Taylor.
Sci, Vol 159, No 3818, pp 994-995, March 1, 1948. 2 p, 1 fig, 1 tab.

Descriptors: *Desert-plants, Semiarid climates, Air temperature, *Energy budget, Radiation, Wind velocity, Humidity, *Measurement, Temperature, *Leaves, Solar radiation, Water vapor, Transpiration, Computer programs, Diffusion, Resistance.
Identifiers: *Leaf temperature, *Radiometer.

The leaf temperatures of many plants of semiarid regions are very near air temperature. A new pistol-grip infrared radiometer was used to measure the leaf temperature of 7 plant species. The leaf temperatures of all plants except Opuntia were within 2 or 3 degrees of air temperature. The blade temperatures of Opuntia were 10 to 16 degrees above air temperature. Theoretical justification for the observation was given based on an energy budget analysis. The energy budget for a plant leaf was programmed for computer analysis for any given value of radiation absorbed, air temperature, wind speed, relative humidity, leaf size and diffusion resistance. The leaf temperature has a direct effect on the transpiration rate of plants in arid climates. (Blecker-Arizona)
W69-02749

CHANGES IN EVAPORATION RATES ALONG A 17-KM TRANSECT IN THE SUDAN GEZIRA,
Nottingham Univ. (England). School of Agriculture.
D. C. Davenport, and J. P. Hudson.
Agr Meteorol, Vol 4, No 5, pp 339-352, September 1967. 14 p, 10 fig, 1 tab, 20 ref.

Descriptors: *Evaporation, Evaporators, *Transpiration, *Water vapor, *Wind velocity, Cotton, Advection, Irrigated land, Vapor pressure, Evaporation pans, Air temperature, Variability, Arid climates, Meteorological data.
Identifiers: Sudan, Upwind, Downwind.

This paper discussed magnitude and extent of lateral variation of evaporative demand in winter in large fields of cotton lying downwind of dry areas, along a 17 km transect in the Sudan Gezira scheme. Evaporation rates were measured from open water in Hudson evaporimeter dishes. At the leading edge of each cotton field evaporation was greatest at the upwind boundary and decreased logarithmically with distance inside the cotton field. Greatest decrease in evaporation in the lateral direction--about 30%--occurred within the first 60 m of a cotton field. On days of high evaporative potential, transpiration from the upwind border area of cotton increased the concentration of water vapor in the air more quickly than on days when evaporation was less severe. The rate of evaporation per day appeared to be highly influenced by the daily wind run that was measured at a height of 2 meters above ground at both windward and leeward edges of the field. (Blecker-Arizona)
W69-02753

WATER BALANCE AND EVAPORATION STUDIES,
Poona Observatory (India).
M. Rama Rao.
Nature, Vol 209, No 5012, pp 776, November 20, 1965. 1 p, 1 fig.

Descriptors: *Water balance, *Evaporation, *Winter, *Soil moisture, Condensation, Air-earth interfaces, Radiation, Wavelengths, Surfaces, *Temperature, Vapor pressure.
Identifiers: India, *Penman's equation.

During the winter months on clear-sky days systematic measurements were made to find the surface soil moisture over Poona, India. It was found that there was a daily variation of soil moisture, reaching a minimum at the maximum epoch of temperature and a maximum at the minimum temperature epoch. It appeared from Penman's equation for evaporation that both during day and night there was a process of condensation taking place near the surface of the earth which in the day was completely outbalanced by the incoming short-wave radiation, resulting in a net evaporation. In arid and semi-arid zones this factor is important for the study of water balance in relation to crop development in winter and may explain the large vegetation growth during these months when there is no rainfall. (Blecker-Arizona)
W69-02764

CALCULATED AND OBSERVED EVAPORATION IN A DRY MONSOONAL ENVIRONMENT,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research.
W. R. Stern, and E. A. Fitzpatrick.
J Hydrol, Amsterdam, Vol 3, No 3, pp 297-311, November 1965. 15 p, 4 fig, 3 tab, 21 ref.

Descriptors: *Evaporation, *Arid climates, Evaporation pans, Evaporators, Regression analysis, Vapor pressure, Air temperature, Climatology, *Dry seasons, Monsoons, *Wet seasons, Data collections, Analysis, Meteorological data, Variability.
Identifiers: *Penman's formula, Formulas, Australia, Evaporimeters.

A study was conducted in Australia to evaluate Penman's evaporation formula and to analyze errors resulting from the use of several types of data. A considerable improvement in the evaporation estimate was achieved by modifying some of the empirical constrants in the formula. The evaluations together with tank evaporation data provided a reference against which other observations and estimates could be matched. The analysis was carried out with specific reference to selected wet and dry periods of the year. Evaporimeters and Dalton type relations showed a slight lag behind Penman evaporation and that the Thornthwaite and Blaney and Criddle estimates were inadequate to describe either the Penman or tank evaporation regime throughout the year in the climatic environment under study. No single relationship could be identified that would satisfy both wet and dry periods of the year in the arid climate. (Blecker-Arizona)
W69-02765

A PAN-LAKE EVAPORATION RELATIONSHIP,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Meteorological Physics.
E. K. Webb.
J Hydrol, Amsterdam, Vol 4, No 1, pp 1-11, April 1966. 11 p, 2 fig, 1 tab.

Descriptors: *Evaporation pans, *Evaporation, *Equations, Diurnal, Solar radiation, Wind velocity, Temperature, *Heat budget, *Lakes, Monthly, Vapor pressure, Water temperature, Numerical analysis, Regression analysis.
Identifiers: *Water budget, Pan factor, Pan conversion.

The pan conversion relationship was investigated and its numerical coefficient evaluated. This was done by making a comparison with the primary determination of evaporation from the water budget, taking only those days which were rated as 'class A' for the latter determination. The pan conversion method, using the equation that was developed, can provide an estimate of daily lake evaporation from nearby class A pan observations. With observations of reasonably high quality, the standard error of monthly total estimated evaporation would be less than 10%. The equation can be used to estimate lake evaporation in arid climates. (Blecker-Arizona)
W69-02766

EFFECT OF ANTITRANSPIRANT TREATMENT ON LEAF TEMPERATURES,
Hebrew Univ., Jerusalem (Israel). Dept. of Botany.
For primary bibliographic entry see Field 03F.
For abstract, see .
W69-02767

2E. Streamflow and Runoff

SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA (OCT 1958-SEPT 1965),
Geological Survey, St. Paul, Minn.
Lowell C. Guetzkow, and Kurt T. Gunard.
U S Geol Surv open-file rep, 162 p, Jan 1967. 11 fig, 1 tab.

Descriptors: *Data collections, *Stage-discharge relations, *Small watersheds, *Minnesota, Floods, Streamflow, Hydrographs, Stream gages, Gaging stations, Flow characteristics, Peak discharge.
Identifiers: *Crest-gage stations, Flood peak, Flood measurements.

The flooding of small streams in Minnesota was investigated to provide data for construction of bridges, culverts, and other drainage structures for highways. The program provides flood data on streams having drainage areas generally less than 50 sq mi, with particular emphasis on those with areas less than 10 sq mi. The basin parameters investigated for their effect on floods are drainage area, length of main stream, slope of main stream, stream density, relief ratio, basin shape, and vegetal cover. Each of 137 gaging stations has a crest-stage gage, and 85 stations have continuously recorded stage gages and recording rain gages. Hydrographs are drawn for significant floods for most of the recording stations. Each station record contains location, drainage area, records available, type of gage, culvert invert elevations, bankfull stage, and annual maximum stage-discharge data. (Knapp-USGS)
W69-02494

WATER RESOURCES DATA FOR ARIZONA, 1967 (PART 1: SURFACE WATER RECORDS).
Geological Survey, Tucson, Ariz. Water Resources Div.

U S Geol Surv, Water Resources Div, Ann Rep, Part 1, 237 p, 1967. 4 fig.

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Descriptors: *Data collections, *Surface water, *Arizona, Discharge (Water), Gaging stations, Stream gages, Streamflow.
Identifiers: Periodic observations.

The 1967 surface-water records for Arizona, from gaging stations, partial-record stations, and miscellaneous sites, are compiled. Each record includes location of station, drainage area, records available, type and history of gage and control, average discharge, extremes, remarks, and daily discharge. A map of Arizona shows locations of active gaging stations. (Knapp-USGS)
W69-02496

WATER RESOURCES DATA FOR CALIFORNIA, 1967 (PART 1: SURFACE WATER RECORDS).
Geological Survey, Menlo Park, Calif. Water Resources Div.

U S Geol Surv, Water Resources Div, Ann Rep, Part 1, Vol 1, 488 p, 1967. 4 fig.

Descriptors: *Data collections, *Surface waters, *California, Streamflow, Discharge (Water), Gaging stations, Stream gages, Streamflow.
Identifiers: Periodic observations.

The 1967 surface-water records for the Colorado River Basin, the Southern Great Basin, and Pacific Slope Basins (excluding the Central Valley) of California, from gaging stations, partial-record stations, and miscellaneous sites are compiled. Each record includes locations of station, drainage area, records available, type and history of gage and control, average discharge, extremes, remarks and daily discharge. A map of California shows locations of active gaging stations. (Knapp-USGS)
W69-02497

EFFECTS OF CULTURAL CHANGES ON MAKARA EXPERIMENTAL BASIN,
Ministry of Works, Wellington (New Zealand). Water and Soil Div.
For primary bibliographic entry see Field 03B.
For abstract, see .
W69-02502

FLOOD FREQUENCY AND CHANNEL CROSS-SECTION OF A SMALL NATURAL STREAM,
Bureau of Public Roads, Washington, D. C.
W. D. Potter, F. K. Stovicek, and D. C. Woo.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 66-76, Sept 1968. 11 p, 5 fig, 3 tab, 10 ref.

Descriptors: *Flood forecasting, *Small watersheds, *Hydrograph analysis, *Stage-discharge relations, Prediction, Flood plains, Runoff, Channels.
Identifiers: Pilot study, 10-yr flow.

Based on some observed characteristics of the depths and the cross-sectional areas of channels and the use of the stage-discharge relationship, a promising simple method of establishing the runoff for a recurrence interval of about 10 years on the upper frequency curve for an ungaged small stream is presented. This method was tested successfully on a number of sample streams in the eastern part of the United States with drainage areas less than 400 square miles. This method applies only to stable natural streams without any man-made deterrent to the natural development of the stream channel or flood plain.
W69-02505

A NEW METHOD OF FLOW ROUTING,
Texas Univ., Austin.
D. M. Himmelblau, and R. V. Yates.
Water Resources Res, Vol 4, No 6, pp 1193-1199, Dec 1968. 7 p, 4 fig, 1 tab, 14 ref.

Descriptors: *Routing, *Unsteady flow, *Streamflow forecasting, Kinetics, Hydrographs, Mathematical studies, Methodology.
Identifiers: Population balance, Routing methods.

A mathematical model for flood routing is presented, using a population balance approach to predict the excess flow above the normal channel flow with four coefficients that can be evaluated at a downstream point from pulses of water upstream. Furthermore, the parameters can be directly related to the general characteristics of the stream in terms of hold up, bypassing, and dead space. The model itself comprises two parallel series of well-mixed vessels without interchange of water and can be modified to make the model more complex. Application of the model to data from the Colorado River in Texas indicates that the model satisfactorily represents the excess flow for pulselike stream releases.
W69-02510

FLOODS ON LICKING RIVER IN VICINITY OF SALYERSVILLE, KENTUCKY,
Geological Survey, Louisville, Ky.
Curtis H. Hannum.
U S Geol Surv open-file rep, 17 p, May 1968. 7 fig, 1 plate, 2 photo.

Descriptors: *Data collections, *Floods, *Kentucky, Hydrologic data, Discharge (Water), Stage-discharge relations, Streamflow, Flood protection, Flood plains.
Identifiers: Licking River, Salyersville (Kentucky), Flood frequency, Flooded areas.

Floods on Licking River near Salyersville, Kentucky, were studied to obtain hydrologic data that can be used to evaluate the extent, depth, and frequency of floods that affect the economy of developments on the flood plains. The data provides a basis for solving existing flood plain problems and for regulating future land use and development to reduce future flood damage by building and zoning regulations, locating waste disposal and water treatment facilities, and developing recreational areas. The areas inundated by 5, 25, and 50-yr floods are shown on a topographic map, scale 1:12,000. Heights of floods are tabulated. Annual floods are shown graphically demonstrating the irregularity of flood heights and the typical magnitudes of floods. For each gaging station in the area, flood discharges and gage heights are tabulated. Major flood profiles are drawn. The frequency-gage height relationship is shown graphically. (Knapp-USGS)
W69-02514

STREAMFLOW INCREASES FOLLOWING FARM ABANDONMENT ON EASTERN NEW YORK WATERSHED,
State Univ. of New York, Syracuse. Coll. of Forestry.
Peter E. Black.
Water Resources Res, Vol 4, No 6, pp 1171-1178, Dec 1968. 8 p, 4 fig, 1 tab, 14 ref.

Descriptors: *Water yield, *Runoff, *Reforestation, *Land use, Small watershed, Interception, Evapotranspiration, New York, Rural areas, Precipitation (Atmospheric).
Identifiers: *Streamflow increases, *Abandoned farms.

Analyses of long-term records of temperature, precipitation, and streamflow for the Wappinger Creek watershed, southeastern New York indicate that streamflow is slowly but steadily increasing as the result of farm abandonment and natural reforestation. An increase in the length of the shortest one-quarter flow internal is apparent. Potential evapotranspiration remains constant, but percentages of precipitation occurring as runoff, dormant season runoff, and total runoff have all increased in recent years. The lengthening of the shortest one-quarter flow internal, the seasons of flow increase, and the brushy nature of the vegetation suggest that increased snow accumulation, shading, and prolonged melt are principal causes for the observed increases in annual and dormant season runoff. (Lang-USGS)
W69-02520

A NOTE ON THE AVERAGE PROBABILITY OF EXTREME EVENTS,
Geological Survey, Miami, Fla.
Charles A. Appel.
Water Resources Research, Vol 4, No 6, pp 1359, December 1968. 1 p, 1 tab, 2 ref.

Descriptors: *Probability, *Floods.
Identifiers: *Average probability, *Extreme events, K-year flood, Plotting-position-probability.

In a recent paper, Benson showed that the limiting value of the average probability of all floods above the K-year flood is equal to 1/2K when the California, Weibull, or Hazen formulas are used to determine plotting positions. This article shows that the limiting value of the average probability is 1/2K for any plotting-position-probability formula of the form $p = (m+a) / (n+b)$ where m is the rank with the highest value taken as 1, n is the number of ranked events, and a and b can be selected arbitrarily, except that b cannot be a negative integer. It is shown that the average probability of floods that equal or exceed K-year floods, out of a series of n floods, 1/2K, when n becomes arbitrarily large. (Seneca-Rutgers)
W69-02548

SOME RECENT STUDIES ON NUMERICAL FLOOD ROUTING,
North Carolina State Univ., Raleigh.
Michael Amein.
Proc Ser No 3, Symp Amer Water Resour Ass, San Francisco, Calif, pp 274-284, Nov 1967. 11 p, 6 fig, 11 ref.

Descriptors: *Flood routing, *Numerical method, Hydrology, Unsteady flow, Computer programming, Computer programs, Differential equations, Finite differences, Flood hydrographs.

Results are presented of an investigation on certain fundamental aspects of numerical flood routing, based on the solution of unsteady flow equations. A brief review of the approximate methods and their solutions is given. This is followed by a discussion of 3 selected complete methods, including factors affecting the stability and accuracy of the solutions. Solution of a flood flow problem on the IBM-360 system illustrates the method. Results are presented and some conclusions are derived on the merits and possibilities of the various methods. (USBR)
W69-02588

SOME COMMENTS ON REGIONALIZATION IN HYDROLOGIC STUDIES,
Geological Survey, Arlington, Va.
For primary bibliographic entry see Field 08C.
For abstract, see .
W69-02667

WATER RESOURCES OF GRANT AND HOT SPRING COUNTIES, ARKANSAS,
Geological Survey, Washington, D. C.
H. N. Halberg, C. T. Bryant, and M. S. Hines.
U. S. Geol Surv Water-Supply Pap 1857, 64 p, 1968. 12 fig, 6 plate, 12 tab, 82 ref.

Descriptors: *Water resources, *Arkansas, Streamflow, Duration curves, Hydrographs, Hydrologic data, Water wells, Specific capacity, Aquifers, Water quality, Water yield, Water utilization, Nitrates, Acid mine water, Water pollution.
Identifiers: Grant County (Arkansas), Hot Spring County (Arkansas).

The availability and quality of groundwater and the lithology of the principal aquifers are described and information is given on surface water availability, including magnitude and frequency of floods and low flows, duration of daily flows, and storage requirements for dependable yields of streams. Quality of water in Ouachita and Saline Rivers and many tributary streams is described, and existing or potential river and groundwater pollution is cited. The Ouachita, Saline, and Caddo Rivers yield large

quantities of soft, good-quality water. Small streams in southeastern Hot Spring County and in the Ouachita Mountains have relatively high base flow; in Grant County small streams yield little water during dry periods. At times, sewage and mine drainage pollute a part of Ouachita River in the Lake Catherine area. At low flow, Hurricane Creek water is unfit for most uses. Wells in the Sparta Sand, the principal aquifer, yield as much as 850 gpm of soft water in Grant County. The Carrizo Sand and Cane River Formation are potentially important aquifers in Grant County and southeastern Hot Spring County. Wells in the Wilcox Group yield as much as 300 gpm of fresh water in southeastern Hot Spring County and southwestern Grant County; in the rest of Grant County its water is brackish. Alluvium along the principal streams and in consolidated rocks of the Ouachita Mountains yield small quantities of water variable in quality from place to place. Some of the alluvial water has high nitrate content and may be a health hazard. (Lang-USGS)
W69-02677

A RECONNAISSANCE OF THE WATER RESOURCES OF PICKENS COUNTY, SOUTH CAROLINA,
Geological Survey, Columbia, S. C.
F. A. Johnson, George E. Siple, and T. Ray Cummings.
S C Water Resources Planning and Coordinating Comm Rep No 1, 69 p, 1968. 17 fig, 1 plate, 15 tab, 27 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *South Carolina, Water yield, Water quality, Hydrogeology, Base flow, Water wells.
Identifiers: Pickens County (South Carolina).

The magnitude and frequency of low flows in Pickens County, S C, have been estimated from gaging station records and from a reconnaissance investigation conducted during 1967. Average flows and 7-day low flows have recurrence intervals of 2 and 10 years have been computed for 26 stream locations. The 2-year (median), 7-day low flows range from about 0.3 cfs per square mi in the southern part of the county to about 0.9 cfs per square mi in the mountainous north. Storage requirements based on low-flow recurrence intervals of 5 and 10 years have been computed also. At most locations surface water in Pickens County has a low dissolved-solids content and is generally suitable for most uses. Wells less than 250 ft deep yield from 1/2 gpm to 500 gpm and an average yield of 21 gpm. Wells in saprolite have the highest yields. Baseflow discharges are 0.3-0.7 million gal per square mi, the maximum potentially available for groundwater withdrawal. Groundwater is of good to excellent quality for most uses. The water is soft, slightly acidic, and low in dissolved solids. (Knapp-USGS)
W69-02679

MEASURING AND SAMPLING RUNOFF FROM FLAT LANDS,
Agricultural Research Service, Washington, D. C.; and Louisiana State Univ., Baton Rouge. Agricultural Experiment Station.
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-02682

EVALUATION OF CHANNEL CHANGES IN ST. CLAIR AND DETROIT RIVERS,
Weather Bureau, Chicago, Ill.
Ivan W. Brunk.
Water Resources Res, Vol 4, No 6, pp 1335-1346, December 1968. 12 p, 6 fig, 3 tab, 9 ref.

Descriptors: *River flow, *Channel improvement, *Great Lakes, Lake Erie, Lake Michigan, Lake Huron, Stage-discharge relations, Stream gages, Hydrographs.
Identifiers: St. Clair River, Detroit River, Streamflow estimates.

Extensive improvements for navigation have been made in the St. Clair-Detroit River (SCDR). Channel changes have lowered the level of Lake Michigan-Huron by about 2 feet, bringing about the lowest levels of record in 1964 and 1965. The unrecognized changes in the regimen of the SCDR before 1900 have also resulted in the computation of flows that are much too large. The discharge of Lake Erie and the precipitation in the Erie basin are used to derive more reasonable estimates of the flow of the SCDR before 1900. The amount of material excavated from channels and the annual differences in reported and computed flow of the SCDR from 1869-1908 are tabulated. Hydrographs show computed flow and Lake Erie flow from 1860-1967.
W69-02693

ESTIMATING FLOOD PEAKS FROM SMALL SOUTH AFRICAN CATCHMENTS,
Colorado State Univ., Fort Collins.
B. M. Reich.
J Hydrol, Amsterdam, Vol 3, No 3, pp 231-253, November 1965. 23 p, 10 fig, 3 tab.

Descriptors: *Flood forecasting, *Storm runoff, Surface runoff, *Rainfall, *Rational formula, Rainfall intensity, Rainfall-runoff relationships, Cover crops, Watersheds (Basins), Peak discharge, Maximum probable flood, Hydrograph analysis, Infiltration, Runoff coefficient, Depth-area-duration analysis.
Identifiers: Cover factor, South Africa.

An attempt was made to replace the 'rational' formula with another rapid and simple means of predicting flood peaks for ungauged watersheds in South Africa that ranged in size from one-fifth to five square miles. Estimates of flood runoff were based on the causative factor, rainfall. The rainfall extremes needed by the method were given. A method was presented by which the 30-minute rainfall extreme can be employed to predict flood peaks very rapidly. Development of the method from the theoretical and empirical concepts was outlined. Results obtained with the method check satisfactorily against eighty-three observed floods recorded in the United States. The method outlined in the study could be used to estimate flood peaks from small catchments in arid climates. (Blecker-Arizona)
W69-02751

RADIOACTIVE TRACING OF STORM RUNOFF ON A SMALL CATCHMENT I EXPERIMENTAL TECHNIQUE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. H. Pilgrim.
J Hydrol, Amsterdam, Vol 4, No 4, pp 289-305, 1966. 17 p, 2 fig.

Descriptors: *Storm runoff, *Tractors, *Radioisotopes, *Tracking techniques, Watersheds (Basins), *Instrumentation, Flood forecasting, On-site tests, Rainfall-runoff relationships, Adsorption, Safety factors, Flow measurement, Sampling, Analytical techniques, Logging (Recording), Calibrations.
Identifiers: Time of concentration.

Time of travel of flood runoff from a 96 acre catchment was directly measured by means of radioactive tracers. The objective of the tracing was to investigate the time of concentration and its variations. The tracer was injected at the most remote point on the catchment and time of travel to the outlet was measured under various conditions. Requirements and types of tracers were discussed, together with safety aspects of the project and performance of the tracers. Several of the major problems encountered in the project were associated with the fact that heavy rainfall and runoff could only be predicted a short time in advance and with low accuracy. Solution of these problems were given. Chromium-51-EDTA had satisfactorily fulfilled requirements of a tracer since adsorption losses were fairly small under conditions of very high dilution and high surface contact. Radioisotopes could probably be used to trace storm runoff from arid areas. (Blecker-Arizona)
W69-02769

RADIOACTIVE TRACING OF STORM RUNOFF ON A SMALL CATCHMENT II DISCUSSION OF RESULTS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. H. Pilgrim.
J Hydrol, Amsterdam, Vol 4, No 4, pp 306-326, 1966. 21 p, 8 fig, 1 tab.

Descriptors: *Storm runoff, *Tracers, *Tracking techniques, *Radioisotopes, *Unit hydrographs, Discharge (Water), Adsorption, Pear discharge, Rainfall intensity, Rainfall-runoff relationships, Watersheds (Basins), Depth-area-duration analysis, Raindrops, Time lag, Precipitation excess, Hydrographs, Runoff.
Identifiers: Time of concentration.

The results of tracing the storm runoff on a 96 acre natural catchment by means of radioactive tracers were discussed. The record of radioactivity with time at the catchment outlet gave a graph of concentration with time of the labeled molecules in the runoff. The record of activity provided a hydrograph of outflow of the labeled drop of water. Consideration of the form of those records enabled clarification of the concept of time of concentration. Application of time travel measurements to a number of hydrograph synthesis methods was discussed. The results provided information on several aspects of the storm runoff process, including the validity of linear analysis, and apparent partial area runoff production effect and the distribution of initial loss. Tracing of storm runoff from arid lands could possibly be done by use of radioactive tracers. (Blecker-Arizona)
W69-02770

RUNOFF HYDROGRAPHS FROM SMALL TEXAS BLACKLANDS WATERSHEDS,
Agricultural Research Service, Washington, D. C.; and Texas Agricultural Experiment Station, College Station.
James R. Williams.
Agricultural Research Service ARS 41-143, pp 1-24, Oct 1968. 24 p, 11 fig, 1 map, 3 tab, 3 ref.

Descriptors: Hydrographs, *Hydrograph analysis, Runoff, *Rainfall-runoff relationships, Watersheds (Basins), Precipitation intensity, *Small watersheds, *Texas.

Runoff hydrographs for ungaged watersheds, ranging in size from 0.275 to 17.6 square miles, in the Blacklands of Texas can be estimated with considerable accuracy by employing certain empirical relationships. These relationships, based on a study of gaged watersheds in the Blacklands, provide estimates of: (1) The peak rate of runoff, (2) the time to peak, and (3) the ordinates of the hydrographs. These relationships require an independent estimate of the volume of runoff; the rainfall intensity for a time period equal to the recession constant; and measurements of certain dimensions of the watershed including area, length of the main stem, slope of the main stem and the elongation ratio.
W69-02794

MATHEMATICAL SIMULATION OF SMALL WATERSHED HYDROLOGIC PHENOMENA,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-02798

APPLICATION OF AN ELECTRONIC ANALOG COMPUTER TO THE PROBLEMS OF RIVER BASIN HYDROLOGY,
Utah Water Research Lab., Logan.

For primary bibliographic entry see Field 02A.
For abstract, see .
W69-02799

2F. Groundwater

PROCEEDINGS SYMPOSIUM ON HYDROLOGY OF THE COASTAL WATERS OF NORTH CAROLINA.
North Carolina Univ., Chapel Hill.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-02487

UNSTEADY DRAWDOWN IN AN UNCONFINED AQUIFER,
Wisconsin Univ., Madison. Dept. of Civil Engineering.
D. T. Higgins.
Ph. D. Thesis, Water Resources Center, 1968. 135 pp, 22 fig, 10 tab, 4 append. owrr project A-005-Wis.

Descriptors: Aquifers, Drawdown, Mathematical models, Saturated flow, Unsteady flow.

A theory is needed which accounts for vertical velocity effects in the unsteady drawdown of a two-dimensional, unconfined aquifer adjacent to a stream or reservoir. Present theories inadequately describe water table motion near the outflow face soon after the stream has been drawn down. In this investigation classical potential theory was used to include vertical velocity effects in the drawdown equation. Linear integral solutions were obtained which predict the water table's position as a function of time for both instantaneous and time-dependent stream drawdown. These equations have been solved numerically. For large values of a dimensionless time factor it is shown that these solutions are identical to those of Stallman and Hantush for the corresponding drawdown of confined aquifers. Closed form approximations to these solutions were also obtained for small values of the time factor. Experiments were performed in a sand filled seepage flume to verify the new theory. It was found that the inclusion of vertical velocity effects extends the range of water table drawdown prediction beyond that available with the linearized shallow aquifer solution of Stallman. (Author)
W69-02490

WATER-LEVEL CHANGES IN GRANT AND STANTON COUNTIES, KANSAS, 1939-1968,
Kansas State Board of Agriculture. Div. of Water Resources.
John D. Winslow, Harold E. McGovern, and Harris L. Mackey.
Kans Univ State Geol Surv, Spec Distribution Publication 37, 17 p, 1968. 5 fig, 2 tab, 6 ref.

Descriptors: *Water level fluctuations, *Kansas, Irrigation, Recharge, Evapotranspiration, Hydrographs.
Identifiers: Grant County (Kansas), Stanton County (Kansas), Pumpage.

Water level data collected since 1939 in Grant and Stanton Counties, Kansas, are analyzed. Because withdrawals for irrigation have consistently and increasingly exceeded recharge, groundwater levels trend downward with time. The number of irrigation wells increased from 15 in 1940 to 850 in December 1967, when 263,000 ac were irrigated. The drought of 1953-1956 greatly increased both withdrawal for irrigation and water-level decline. Locations of wells, water level declines, and irrigated areas are mapped. Hydrographs of selected wells are included. (Knapp-USGS)
W69-02491

DIFFUSION AND DISPERSION IN POROUS MEDIA--SALT WATER MOUNDS IN COASTAL AQUIFERS,
North Carolina State Univ., Raleigh.
Abdel-Aziz I. Kashef.
N C Water Resources Res Cent Rep No 11, 258 p, Sept 1968. 39 fig, 12 tab, 85 ref, 8 append. OWRR Project A-007-NC.

Descriptors: *Saline water intrusion, *Diffusion, *Aquifers, *Saline water-freshwater interfaces, Pumping, Recharge, Confined water, Dupuit-Forchheimer theory, Unsteady flow, Model studies, Hydraulic models.
Identifiers: *Coastal aquifers, Leaky confining beds.

A mathematical model of the movement of fresh and salt waters in coastal aquifers in which fresh water is withdrawn by wells is presented. The location of the fresh-salt water interface in artesian and unconfined aquifers is determined on the basis of analysis of hydraulic forces in the body of fresh water. The 3-dimensional flow systems are developed by analogy to 2-dimensional finite-length systems. Dupuit-Forchheimer assumptions are entirely eliminated. Results compare favorably with the best previous techniques but the method is simpler. A FORTRAN program for the IBM 360 was used to obtain dimensionless solutions for 130 cases and the results are summarized in tabular and graphic forms. In field cases many results can be attained easily on a desk calculator. A Hele-Shaw model was constructed to study 2 dimensional flow of 2 immiscible fluids of different viscosities in transient and steady flow. Salt water intrusion was studied combining the effects of natural flow and multiple well pumpage. (Knapp-USGS)
W69-02495

ON THE IMPULSE RESPONSE OF AN AQUIFER,
City Univ., London (England). Dept. of Civil Engineering.
C. Venetis.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 136-139, Sept 1968. 4 p, 2 fig, 1 tab, 9 ref.

Descriptors: *Mathematical studies, *Dupuit-Forchheimer theory, *Aquifer, *Unsteady flow, Groundwater movement, Laplaces equation, Porous media.
Identifiers: Impulse response, One-directional semi-infinite aquifer, Boundary conditions.

The impulse response and the response to a unit step function of the one-directional semi-infinite aquifer is given, derived from the approximate partial differential equation of groundwater flow. An example is presented.
W69-02500

A STUDY OF SALT WATER ENCROACHMENT IN THE COASTAL AQUIFER AT DIGHA, MIDNAPORE DISTRICT, WEST BENGAL, INDIA,
Geological Survey, Calcutta (India).
A. B. Goswami.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 77-87, Sept 1968. 11 p, 6 fig, 2 tab, 6 ref.

Descriptors: *Saline water intrusion, *Saline water-freshwater interfaces, *Aquifers, *Coasts, Pumping, Recharge, Tides, Recharge, Wells, Hydrodynamics.
Identifiers: India, Digha, Bay of Bengal, Phreatic aquifer.

Between 1963 and 1965, sinking of auger boreholes .nd testing of quality of groundwater at different depths along the Digha coast of India provided the principal basis for defining the distribution and movement of the saline and fresh groundwater within a phreatic aquifer (7-9 metres in thickness) consisting of fine to coarse grained sand with occasional soft clay lenses of Recent age. The auger holes were sunk along 10 lines in an area of about 25 sq km extending from 3 km east of Digha on the east to the confluence of the Subarnarekha river with the Bay of Bengal on the west. The results of the study revealed the existence of a fresh water wedge (chloride content varying from 20 to 300 ppm) separated by two saline water zones, one near the top and the other at the bottom of the aquifer. The isochlor of 500 ppm and 2.3 chloride-bicarbonate ratio delineated the saline groundwater body. The 300 and 500 ppm isochlors defined the zone of diffusion which had a variable shape and thickness depending on several factors. Minor movements of the interface occur due to tidal and groundwater recharge variations. The interface was found to occur at much shallower depth than that calculated on the basis of the Ghyben-Herzberg principle.
W69-02504

AXISYMMETRIC SEEPAGE THROUGH HOMOGENEOUS AND NONHOMOGENEOUS POROUS MEDIUMS,
Roland W. Jeppson.
Water Resources Res, Vol 4, No 6, pp 1277-1288, Dec 1968. 12 p, 5 fig, 21 ref.

Descriptors: *Infiltration, *Porous media, *Soil water movement, *Mathematical models, Digital computers, Stokes law, Approximation method, Pit recharge, Homogeneity, Heterogeneity.
Identifiers: Axisymmetric seepage, Finite difference methods.

Solutions to steady-state free surface seepage from axisymmetric ponds through homogeneous and nonhomogeneous porous media to a drained layer at a finite depth are obtained by finite difference methods. In the formulation of the boundary value problems, the magnitudes of the radial and axial coordinates are considered dependent variables in the plane defined by the potential function and Stokes' stream function. Example solutions are given for seepage through (1) a homogeneous porous medium; (2) a nonhomogeneous porous medium in which the permeability decreases with depth; and (3) a nonhomogeneous porous medium in which the permeability increases with depth. The methods and techniques employed are equally applicable to other three-dimensional seepage and potential fluid flow problems with axial symmetry and free surfaces. The essential differences in the formulation and solution to other problems will be the boundary conditions.
W69-02511

STEADY INFILTRATION FROM A SHALLOW CIRCULAR POND,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 02G.
For abstract, see .
W69-02512

WATER-LEVEL TRENDS IN SOUTHEASTERN LOUISIANA,
Geological Survey, Baton Rouge, La. Water Resources Div.
D. C. Dial.
La Dep of Conserv et al, Water Resources Pam No 22, 11 p, May 1968. 2 fig, 1 pl, 4 ref.

Descriptors: *Water level fluctuations, *Groundwater movement, *Aquifer characteristics, *Water utilization, Louisiana, Deep wells, Pressure head, Hydrographs, Geohydrologic units, Water table.
Identifiers: *Water level trends, Declining head, Groundwater wastage, Flowing wells.

Current water-level trends are described for aquifers in a 5-parish area lying between Lake Pontchartrain and the Mississippi line, and conditions that have brought about the trends are discussed. Areas of moderate to heavy groundwater withdrawals are shown on a map and water level trends are graphed for 10 widely-spaced observation wells for the period 1960-1966. Relatively large declines have occurred in deep artesian aquifers, but little or no declines are evident in shallow aquifers. In the deep aquifers, declines range from 5 ft per yr in Western Livingston Parish to 1 ft per yr in areas more remote from heavy withdrawals. Moderate withdrawals, such as at Slidell and Hammond, have caused water-level declines of about 2 ft per yr. A large part of the area's usable groundwater flows to waste from

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unused wells, thus contributing to the declining trends. (Lang-USGS)
W69-02513

NEW THEORY OF RECHARGE TO THE ARTESIAN BASIN OF THE DAKOTAS,
Geological Survey, Denver, Colo.
Frank A. Swenson.
Geol Soc of Amer Bull, Vol 79, pp 163-182, Feb 1968. 20 p, 5 fig, 2 tab, 33 ref.

Descriptors: *Groundwater movement, *Groundwater basins, *Aquifers, *Groundwater recharge, Sandstones, Limestones, South Dakota, Leakage, Karst, Hydrogeology, Water quality, Artesian wells, Confined water, Pressure.
Identifiers: *Dakota Sandstone, Pahasapa Limestone, Englewood Formation.

A new theory of recharge of the Dakota Sandstone in the Dakota Artesian Basin is proposed on the basis of review of older published work and field checking of anomalies discovered in previous explanations. Previously it was believed that the Dakota Sandstone is recharged where it is exposed on the flanks of the Black Hills, and water moves eastward in the sandstone. This is unlikely because no continuous sandstone beds extend from the Black Hills to discharge areas. Head gradient relations and chemical data are also anomalous with regard to this theory. It is proposed that recharge enters the lower Mississippi Pahasapa Limestone and the Englewood Formation on the flanks of the Black Hills. The limestones are very cavernous; streams flowing out of the Black Hills lose most of their water to them. Water moves freely through the cavernous limestone for 100 miles east of recharge until it reaches a zone of Pre-Dakota beveling where the limestones are closer to the Dakota Sandstone and water can move upward to recharge the Dakota Aquifer. Much of the water pumped from the Dakota has moved only a short distance through it. Chemical character and head relations of water in the Dakota support this interpretation. (Knapp-USGS)
W69-02515

LABORATORY EVALUATION OF SELECTED RADIOISOTOPES AS GROUND WATER TRACERS,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 07C.
For abstract, see .
W69-02571

MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-02591

INTRINSIC PERMEABILITY OF HYDROLOGICAL POROUS MEDIUMS: VARIATION WITH TEMPERATURE,
Louisiana State Univ., Baton Rouge.
David B. Greenberg, Ronald S. Cresap, and Terry A. Malone.
Water Resources Res, Vol 4, No 4, pp 791-800, Aug 1968. 10 p, 8 fig, 2 tab, 9 ref.

Descriptors: *Permeability, *Porous media, Groundwater, Momentum equation, Darcy's law, Reynolds number, Turbulent flow, Laminar flow.
Identifiers: *Fluid dynamics, Pore size, Quartz medium.

With attention confined to the laminar and turbulent flow regimes experimental work is reported on intrinsic permeability of hydrological porous mediums as a function of temperature variations. Experimental results show that permeabilities of such mediums are thermally sensitive. For cemented quartz mediums permeabilities varied as much as 0.5% per degree C over a 20-60 deg C temperature range. Despite the temperature effect observed, a satisfactory friction factor correlation was obtained for all data utilizing the two-term momentum equation. Measurements with vitrified mediums showed no appreciable temperature coefficient of permeability. As a by-product of the investigation a characteristic length parameter, in terms of the laminar (permeability) and inertial flow coefficients, was used to define a modified Reynolds number for all porous mediums. This length parameter appears to be directly proportional to the mean pore dimension as determined from porosimetry measurements. Data obtained from all samples correlated well in graphical form and are presented in a generalized friction factor (modified Reynolds number) plot. (Llaverias-USGS)
W69-02664

COMPOSITION OF DEEPER SUBSURFACE WATERS ALONG THE ATLANTIC CONTINENTAL MARGIN,
Geological Survey, Washington, D. C.
F. T. Manheim, and M. K. Horn.
Southeastern Geology, Vol 9, No 4, pp 215-236, Nov 1968. 22 p, 5 fig, 2 tab, 68 ref.

Descriptors: *Groundwater, *Water quality, *Hydrogeology, *Atlantic Coastal Plain, Florida, Georgia, Maryland, North Carolina, South Carolina, Osmosis, Membrane processes, Clays, Filtration, Salinity, Sedimentation, Lagoons.
Identifiers: *Continental margin, Paralic sediments, Barrier islands.

The composition and distribution of deeper groundwaters beneath the Coastal Plain and continental margin of the eastern US were studied by electrical well log evaluation, use of existing water analyses, literature search, and oil-well pore fluid analyses. Meteroic water greatly influences water quality down to 1000 m. In the Georgia-South Carolina area potable water may occur below saltier layers deeper than 1000 m, and more than 120 km offshore. Deeper waters have irregularly arranged brackish and saline zones with a trend of salinity increase with depth. Salinites of over 100,000 ppm are found in pre-Upper Cretaceous rocks in the Salisbury Embayment of Maryland and Delaware, Hatteras embayment, south Georgia and all of Florida. Brines are associated with red-beds and evaporites. Salt filtration by clay membranes does not seem to occur in Coastal Plain sediments, but clay membranes do seem to promote osmotic flushing of salty strata by fresher waters. (Knapp-USGS)
W69-02666

FIELD OBSERVATIONS ON CHANGES IN THE SUBSURFACE WATER REGIME DURING INFLUENT SEEPAGE IN THE SANTA CRUZ RIVER,
Arizona Univ., Tucson. Water Resources Center.
L. G. Wilson, and K. J. De Cook.
Water Resources Res, Vol 4, No 6, pp 1219-1234, December 1968. 16 p, 6 fig, 24 ref.

Descriptors: *Infiltration, *Alluvium, *Groundwater movement, Surface-groundwater relationships, Pit recharge, Arizona, Piezometers, Observation wells, Unsaturated flow, Water levels, Water level fluctuations.
Identifiers: Tucson (Arizona), Santa Cruz River, Groundwater mounds.

Field studies were conducted during the winter 1965-1966 at an instrumented research site near Tucson, Arizona, to characterize changes in the subsurface water regime of the stratified sediments at the site during influent seepage in the Santa Cruz River. At the peak of recharge from the principal runoff event of the winter, observation well data accounted for 33% of the observed total change in the subsurface water content. The remaining 67%, observed by means of moisture logs in access tubes, was contained in two near-saturated mounds in the intermediate vadose zone. Slow drainage of water from these mounds into the semiconfined phreatic zone apparently reduced the rates of recession of observation well hydrographs. Water content changes in the intermediate vadose zone and related long-term drainage should be accounted for during water balance studies and aquifer testing in the Tucson Basin.
W69-02674

WATER RESOURCES OF GRANT AND HOT SPRING COUNTIES, ARKANSAS,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02677

ELECTRICAL-ANALOG ANALYSIS OF HYDROLOGIC DATA FOR SAN SIMON BASIN COCHISE AND GRAHAM COUNTIES, ARIZONA,
Geological Survey, Washington, D. C.
Natalie D. White, and William G. Hardt.
U S Geol Surv Water-Supply Pap 1809-R, 30 p, 1965. 5 fig, 2 plate, 1 tab, 19 ref.

Descriptors: *Analog models, *Forecasting, *Water level fluctuations, *Flow nets, Aquifer characteristics, Water yield, Groundwater, Transmissivity, Storage coefficient, Arizona, Hydrologic data, Water supply, Aquifers.
Identifiers: San Simon basin (Arizona), Cochise County (Arizona), Graham County (Arizona).

Effects of projected ground-water withdrawals from the alluvial-fill aquifer in San Simon basin, Arizona, were determined by an analysis of an electric-analog model of the aquifer. The aquifer system is divided into four units; an upper water-table aquifer, confining layer of blue clay, lower artesian aquifer, and a marginal zone where the two aquifers form one hydrologic unit. Characteristics of the lower aquifer and the confining bed, which were needed to construct the model, were determined by analyzing flow nets, well data, and historical water levels. The analog model provides a thorough analysis of an entire hydrologic system under complex conditions imposed by increased developments. The model was verified and adjusted against a map of net change in water levels from 1915 to 1960. On the basis of an hypothesized amount and distribution of pumpage, analysis of the model indicated water-level declines from 1960 to 1980 of about 120 ft in the Bowie area and about 160 ft in the San Simon area. The water levels in 1980 were predicted by superimposing the decline data on known 1960 data. Correspondence of projected water-level conditions to future field conditions will depend on the conformance of future pumpage to the hypothesized pumpage. (Steinhilber-USGS)
W69-02678

A RECONNAISSANCE OF THE WATER RESOURCES OF PICKENS COUNTY, SOUTH CAROLINA,
Geological Survey, Columbia, S. C.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02679

CONTRIBUTIONS TO THE HYDROLOGY OF ASIA AND OCEANIA--GROUND-WATER HYDROLOGY OF THE PUNJAB, WEST PAKISTAN, WITH EMPHASIS ON PROBLEMS CAUSED BY CANAL IRRIGATIONS,
Geological Survey, Washington, D. C.
D. W. Greenman, W. V. Swarzenski, and G. D. Bennett.
U S Geol Surv Water-Supply Pap 1608-H, 66 p, 1967. 12 fig, 10 plates, 4 tab, 21 ref.

Descriptors: *Groundwater, *Water quality, *Ground-water recharge, *Water table, *Surface-groundwater relationships, Reclamation, Irrigation practices, Ground-water movement, Hydrogeology, Leaching, Seepage, Water yield, Water wells, Water level fluctuation, Hydrologic data, Aquifers, Water management (Applied).

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Identifiers: Water logging, Water quality changes, Hydrologic changes, Punjab (West Pakistan), West Pakistan, Tubewells.

Rising water tables and salinization of land as a result of canal irrigation threaten the agricultural economy of the Punjab, West Pakistan. This report summarizes the findings of an investigation started in 1954 to determine the relations between irrigation activities, natural hydrologic factors, and the incidence of waterlogging and subsurface-drainage problems. Hydrologic findings are: most of the Punjab is underlain to depths of 1,000 ft or more by unconsolidated alluvium, which is saturated to within a few feet of land surface; large capacity wells, yielding 4 cfs or more, can be developed almost everywhere; ground water within a depth of 500 ft averages less than 1,000 ppm of dissolved solids in about two-thirds of the Punjab; total dissolved solids range from 1,000 to 20,000 ppm in the remainder of the area; leakage from canal systems is principal cause of rising water levels and constitutes the major components of ground-water recharge; original relationship between ground and surface waters have been modified. The report concludes that the ground water reservoir, containing about 2 billion acre-feet of usable water, is of great economic and management value. The West Pakistan Water and Power Development Authority's long range plan for reclamation involves the construction of a network of high capacity wells, which will help supply irrigation requirements and provide subsurface drainage. Some quality-of-water changes may result from this reclamation method but the changes will be slow and will not present immediate serious problems. (Steinhilber-USGS)
W69-02680

SALT WATER INTERFACE IN A LAYERED COASTAL AQUIFER,
State Univ. of New York, Buffalo.
Ralph R. Rumer, and J. C. Shiau.
Water Resources Res, Vol 4, No 6, pp 1235-1247, December 1968. 13 p, 14 fig, 10 ref.

Descriptors: *Saline water-freshwater interfaces, *Aquifers, *Coasts, *Anisotropy, Steady flow, Mathematical models, Dupuit-Forchheimer theory, Darcys law.
Identifiers: Isotropic nonhomogeneous aquifers, Anisotropic nonhomogeneous aquifers, Vertical flow components.

The shape and the position of the interface between the seaward flowing fresh water and the underlying salt water in both isotropic and anisotropic nonhomogeneous coastal aquifers were determined. A transformation for the nonharmonic anisotropic layer was introduced so that the governing equations and boundary conditions in the complex potential plane were satisfied. For the nonhomogeneous layers, the homogeneous mathematical models were superimposed under the same dynamical conditions. Solutions of the flow patterns and interface locations are presented in dimensionless form. It was assumed that the aquifers were anisotropic or nonhomogeneous only in the two-dimensional sense. From earlier studies it has been shown that the solutions obtained are valid for both confined aquifers and unconfined aquifers when the length of salt intrusion is greater than the depth of the aquifer.
W69-02683

STEADY DOWNWARD FLOW TO A WATER TABLE,
Asian Inst. of Tech., Bangkok (Thailand).
Anat Arbhabhirama, and Chanaphan Kridakorn.
Water Resources Res, Vol 4, No 6, pp 1249-1257, December 1968. 9 p, 6 fig, 5 ref.

Descriptors: *Unsaturated flow, *Porous media, *Groundwater recharge, Hydraulic conductivity, Capillary conductivity, Anisotropy, Isotropy, Mathematical models, Model studies, Laboratory tests, Infiltrometers.
Identifiers: Stratified porous media, Homogeneous porous media, Capillary pressure.

A partially saturated zone in a porous medium is usually found above a water table when the rate of downward flow per unit area of cross section is less than the hydraulic conductivity of the porous medium. Theoretical solutions describing the distribution of capillary pressure above the water table during steady downward flow are presented. Experiments were conducted, using water as the wetting fluid and air as the nonwetting fluid, for both homogeneous and stratified media. The experimental results show good agreement with the theory.
W69-02684

GEOLOGY AND GROUND-WATER RESOURCES OF THE DEER LODGE VALLEY MONTANA,
Geological Survey, Washington, D. C.
R. L. Konizeski, R. G. McMurtrey, and A. Brietkrietz.
U S Geol Surv Water-Supply Pap 1862, 55 p, 1968. 8 fig, 2 plate, 5 tab, 33 ref.

Descriptors: *Water resources, *Groundwater, *Montana, Hydrologic data, Aquifer characteristics, Water yield, Specific capacity, Hydrographs, Water wells, Gravimetric analysis.
Identifiers: Deer Lodge Valley (Montana), Multiple-well tests.

Principal aquifers, which are Quaternary alluvium and Tertiary sediments in Deer Lodge Valley, Montana, are described and their water availability evaluated. The alluvium which is relatively thin, yields sufficient water for domestic and livestock uses. Locally, in the civinity of Clark Fork and its major tributaries, well yields of several hundred gallons per minute each are available. The Tertiary sediments which are thick and have a variable permeability, generally yield less than 10 gpm per foot of drawdown to wells. However, because of the great thickness of these sediments, yields of 1,000 gpm are available locally. The most likely areas for obtaining higher yielding wells are the flood plain of Clark Fork and the coalescing alluvial fans of Mill and Warm Springs Creeks. The depth to water in the flood-plain area is generally less than 10 feet, but on the fans and terraces it ranges from 10 to 150 feet. Recharge to the groundwater system is sufficient to permit additional withdrawals of water without excessively lowering the water table. (Steinhilber-USGS)
W69-02686

GROUND WATER AND MINERAL WATERS OF CZECHOSLOVAKIA,
Geological Survey of Czechoslovakia, Prague.
Vlastimil Myslil, and Ondrej Franko.
Int Geol Congr, 23d Sess, Prague, No 21 AC, 51 p, 1968. 10 fig, 1 tab, 20 ref.

Descriptors: *Water resources, *Groundwater, *Mineral water, Geohydrologic units, Aquifers, Springs, Water wells, Thermal water, Water supply, Water utilization.
Identifiers: *Czechoslovakia, *Hydrogeology.

A survey of the groundwater and mineral water resources of Czechoslovakia is given in a guide book to excursions in the XIII International Geological Congress. The country's largest groundwater reserves are in the Bohemian Cretaceous Basin in thick extensive Sandstone layers. The deeper aquifers are confined and artesian springs yield up to 100 l/sec. Water supplies are used for cities as far away as Prague. Karst water circulation is well developed in Devonian limestones in Moravia. Pleistocene and younger sands and gravels are of hydrogeologic significance only where they directly communicate with streams. The mineral waters of the Bohemian Massif are of several types, some associated with young tectonic fractures in crystalline rocks and some geothermally heated in sedimentary aquifers. Detailed descriptions of water supply development and mineral water occurrences are included in 32 excursion locality descriptions. (Knapp-USGS)
W69-02689

A REGIONAL INTERBASIN GROUNDWATER SYSTEM IN THE WHITE RIVER AREA, SOUTHEASTERN NEVADA,
Geological Survey, Carson City, Nev. Water Resources Div.
Thomas E. Eakin.
Water Resources Res, Vol 2, No 2, pp 251-271, 1966. 21 p, 6 fig, 6 tab.

Descriptors: Regional analysis, *Groundwater basins, *Nevada, *Valleys, *Hydrologic properties, *Hydrogeology, Groundwater recharge, Discharge (Water), Springs, Hydraulic gradient, Water chemistry, Groundwater movement, Arid lands, Runoff, Carbonate rocks, Precipitation (Atmospheric).
Identifiers: Inter-basin groundwater system.

A report is given which describes the general features of a regional groundwater system consisting of thirteen valleys in a part of the Basin and Range province in southeastern Nevada. Although the scope of the report was limited by the reconnaissance nature of investigations on which it was based, virtually all components of the hydrologic system were evaluated. The interbasin groundwater system was identified on the basis of preliminary appraisals of the distribution and quantities of estimated groundwater recharge and discharge within the region, uniformity of discharge of the principal springs, compatibility of potential hydraulic gradient with regional groundwater movement, relative hydrologic properties of major groups in the region, and, to a limited extent, chemical character of water issuing from the principal springs. Principal findings of the study are reported and discussed. (Affleck-Arizona)
W69-02757

RECHARGE DISTRIBUTION DETERMINED BY ANALOG MODEL,
Arizona Univ., Tucson.
W. G. Matlock.
Groundwater, Vol 4, No 3, pp 13-16, July 1966. 4 p, 7 fig, 1 tab.

Descriptors: *Groundwater recharge, Recharge, Aquifers, Contours, *Maps, *Analog models, Arizona, Electrical equipment, Model studies, Groundwater basins, Distribution patterns, *Spatial distribution, *Natural recharge.
Identifiers: *Santa Cruz River basin (Arizona).

A model study of natural recharge in the lower Santa Cruz River basin of southern Arizona was conducted by the Agricultural Engineering Department of the University of Arizona. To determine the spatial distribution of natural ground-water recharge, a two-dimensional passive element electric analog model was used. A groundwater level contour map of the area in its undeveloped condition was drawn using existing records. By varying inputs from known locations of recharge the model was made to duplicate these contours. Recharge distribution as determined by the model was consistent with previous estimates, but no direct correlation was found with the contributing drainage area. (Affleck-Arizona)
W69-02758

PREDICTING RETURN FLOWS FROM IRRIGATION,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-02762

2G. Water in Soils

OLUTE DISPERSION IN TWO HAWAIIAN OILS UNDER SATURATED FLOW,
lawaii Univ., Honolulu. Water Resources esearch Center.
. G. Cagauan, Jr., L. S. Lau, R. E. Green, and G. ehara.
inth International Congress of Soil Science Trans, ontrib No 6, 1968, Vol 1 Paper 20, pp 185-194, 4 g, 1 tab, 19 ref.

escriptors: *Solute dispersion, Chloride dispersion, Potassium dispersion, Phosphate dispersion, ispersion in Hawaiian soils, *Saturated flow spersion, *Dispersion theory, Dispersion and adrption, Breakthrough curves of chloride potassim and phosphate, One-dimensional dispersion in awaiian soils, Dispersion and adsorption of olutes in Hawaiian soils.

study was conducted to investigate the dispersion chloride, potassium and phosphate in two awaiian soils under saturated flow. A dispersion eory based on a solution of Fick's second law of ffusion was used as a mathematical model. Two w velocities, where diffusion may be neglected, ere selected for each test and the dispersion rves were compared as calculated from theory. A rameter of volume, V sub e, occurring at the arval of one half of initial concentration, was used fit the data to the theoretical. To a certain exnt, V sub e can reflect dispersion with adsorption. general, the breakthrough curves of the solutes ed can be described by the mathematical model. was suggested that other models be investigated r soils exhibiting strong adsorption (or fixation) phosphate. (Author)
69-02405

NFILTRATION IN THE PUKETURUA EXPERIENTAL BASIN,
linistry of Works, Wellington (New Zealand). ater and Soil Div.
. J. Blake, G. D. Mallinson, and P. Lykles.
Hydrol of New Zealand, Vol 7, No 1, pp 38-46, 968. 9 p, 2 fig, 1 tab, 12 ref.

escriptors: *Infiltration, *Sprinkling, Computer ogram, International Hydrological Decade, ettability, Hydrologic properties.
entifiers: *New Zealand, *North Fork infiltrometer.

he first program of infiltration measurement on a ew Zealand I.H.D. experimental basin is outlined, d the major problems found in the work are iefly discussed. From 1965 to 1967 the North ork infiltrometer was used extensively in the Puturua Experimental Basin, Northland, to exnine the infiltration characteristics of the soil nits present. Field techniques using this instruent are evaluated, and efforts to improve it are etched. A new computer program for processing e sprinkling-plot data is described, and the data btained from it are briefly analyzed. (Llaverias-SGS)
69-02492

ARTHFLOWS AND RELATED ENVIRONENTAL FACTORS OF EASTERN OTAGO, EW ZEALAND,
tago Univ., Dunedin (New Zealand). Dept. of eography.
. J. Crozier.
of Hydrol, New Zealand, Vol 7, No 1, pp 4-12, 968. 9 p, 5 fig, 11 ref.

escriptors: *Landslides, *Environmental effects, Loess, *Earth-Water interfaces, *Movement, eathering, Rainfall, Soil moisture, Temperature, vaporation, Solifluction, Stress relieving.
entifiers: *Discrete earthflow, *Extensive rthflow, *Climatic factors, Regolith, New Zeand.

Two types of earthflow (landslides) in the loess-mantled hills of eastern Otago, New Zealand are described. One is recognized as the discrete earthflow, bounded by distinct shear lines, and the other as an older extensive flow with preglacial characteristics. Minor variations in form are related to water content, depth and sensitivity of the regolith. Climatic factors and their influence on varying rates or movement are discussed, particularly seasonal soil moisture content, temperature, evaporation, and rainfall which influence discrete earthflow on the Otago Peninsula. Correlation coefficients indicate that variations in rate of movement are closely associated with rainfall variations during winter-early spring when evaporation and temperature are lowest and soil moisture is high. The effect of rainfall on rate of movement is not immediate but appears to be delayed by about a week. (Lang-USGS)
W69-02508

CALIBRATION AND EVALUATION OF A WIDE-RANGE GRAVIMETRIC METHOD FOR MEASURING MOISTURE STRESS,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02509

AXISYMMETRIC SEEPAGE THROUGH HOMOGENEOUS AND NONHOMOGENEOUS POROUS MEDIUMS,
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-02511

STEADY INFILTRATION FROM A SHALLOW CIRCULAR POND,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
R. A. Wooding.
Water Resources Res, Vol 4, No 6, pp 1259-1273, Dec 1968. 15 p, 8 fig, 1 append, 17 ref.

Descriptors: *Infiltration, *Unsaturated flow, *Porous media, *Soil water movement, *Pit recharge, Mathematical models, Stokes law, Darcys law, Hydraulic conductivity, Isotropy, Anisotropy, Infiltrometers.
Identifiers: *Steady infiltration, *Pond recharge, Philips method, Tranters method, Semi-infinite porous media, Boundary conditions, Australia.

Steady infiltration from a shallow, circular, inundated area on the horizontal surface of a semi-infinite porous medium is treated by a method of linearization proposed by J. R. Philip. Using this method, Philip retains most of the properties of the nonlinear system but reduces the differential equation to a linear type representing steady diffusion in a steady uniform flow. On the surface of the medium, the boundary conditions are of mixed type although linear. These conditions are reduced to a system of dual integral equations solved by a modification of Tranter's method. Expressions for the distributions of vertical flux density, moisture content, and Stokes' stream function are derived, and numerical values of the last two quantities are illustrated graphically. It is found that the total flux depends almost linearly upon a parameter defined as the logarithmic derivative of the hydraulic conductivity with respect to capillary potential. Curves of mean flux over various fractions of the total source radius for various values of the parameter indicate the importance of incorporating a guard ring in infiltrometer design.
W69-02512

SOIL MOISTURE AVAILABILITY FOR TRANSPIRATION,
Drexel Inst. of Tech., Philadelphia, Pa.
F. J. Molz, Irwin Remson, and A. A. Fungaroli.
Water Resources Res, Vol 4, No 6, pp 1161-1169, December 1968. 9 p, 4 fig, 1 tab, 16 ref.

Descriptors: *Soil water movement, *Evapotranspiration, Mathematical models, Diffusion, Unsaturated flow, Root zone, Soil moisture.

A differential equation is presented describing radial flow of soil moisture to a single vertical sink, for instance a root, in an infinite soil mass which is initially at a uniform moisture content. The relationship between moisture content and diffusivity for the soils studied may be represented by an exponential function. A numerical solution of the differential equation is used to determine the soil-moisture flux. The results show that for specific soils the decrease in soil moisture with time occurs mainly in the immediate vicinity of the sink. Moisture flux increases with initial moisture content but is essentially time independent. In natural systems the flux would probably decrease with time because of multiple root interference. At large soil-moisture contents, actual transpiration is limited by and equivalent to potential transpiration. At small soil-moisture contents, actual transpiration is limited by and equivalent to potential soil-moisture availability.
W69-02671

DENSITY AND MOISTURE CONTENT MEASUREMENTS BY NUCLEAR METHODS,
Research Triangle Inst., Durham, N. C.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02676

MODEL EXPERIMENTS ON FLUID FLOW IN THE TRANSITION ZONE FROM UNSATURATED TO SATURATED SOIL,
Bundesanstalt fuer Gewasserkunde, Coblenz, (West Germany).
F. Schwille, W. Lippok, and D. Weisflog.
Proc of Symp, Int At Energy Agency, Vienna, and Europe Nucl Energy Agency, pp 151-160, 1967. 10 p, 10 fig, Discuss.

Descriptors: *Infiltration, *Porous media, *Alluvium, *Lysimeters, *Radioisotopes, Radioactive waste disposal, Groundwater movement, Percolation, Seepage, Unsaturated flow, Model studies, Saturated soils.
Identifiers: Homogeneous media, Unsaturated soil.

Lysimeter studies of the infiltration of water into soil were made in a study of the safety factors of radionuclide-producing plants located on river alluvium in Germany. More than four-fifths of the drinking water in Germany is groundwater or bank-filtered river water. The most important aquifers in the Federal Republic of Germany are fluviatile and fluvioglacial Pleistocene sand and gravel deposits, situated in the valleys of the large rivers. The ground-water level is generally from 3 to 15 m below ground surface. Depending on the permeability of the substrata, about 100 to 300 mm of precipitation water probably infiltrates. These alluvial plains are possible locations for radionuclide-producing plants. However, it is hard to find any locality where such plants would not have a marked effect on the water supply system. To protect groundwater against radionuclide contamination, a detailed knowledge is first necessary of the migration mechanisms of radionuclide-containing solutions both into the unsaturated zone and the saturated zone. Infiltration in the unsaturated zone and spreading in the saturated zone were analyzed with sand models. Large glass lysimeters, experimental troughs with glass walls and small diameter copper and glass segment-tubes were used as models. The liquid fronts were traced mainly with ultra-violet light. The result shows that it is not yet possible to treat the flow of liquid analytically in every case, even in homogeneous media. (Knapp-USGS)
W69-02681

STEADY DOWNWARD FLOW TO A WATER TABLE,
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-02684

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CIRCULATION OF WATER IN SOIL UNDER A TEMPERATURE GRADIENT,
Agricultural Research Service, Tempe, Ariz. Water Conservation Lab.; and Rothamsted Experimental Station, Harpenden (England).
R. D. Jackson, D. A. Rose, and H. L. Penman.
Nature, Vol 205, No 4968, pp 314-316, January 16, 1965. 3 p, 3 fig.

Descriptors: Arid lands, *Soil water movement, *Thermocline, *Saline soils, *Water vapor, Salts, Temperature, Circulation, Equilibrium, Soil dynamics, *Transfer.
Identifiers: Soil column, Circulatory system, Fluxes, Vapor, Non-saline soils.

An experiment was designed to show that when a temperature gradient is applied to a uniform closed soil column, a circulatory system is set up and that any eventual steady moisture distribution is actually a dynamic balance of opposing fluxes, predominantly vapor from hot to cold and predominantly liquid from cold to hot. Saline and non-saline soils were tested. For both materials there was a net water movement from hot to cold, the movement being greater in the absence of salt. When a temperature gradient was applied along a column in which water and salt were initially uniformly distributed, two kinds of transfer were possible. There was a vapor flux moving from hot to cold, and a return liquid flux from cold to hot, indicating that a circulatory system was in effect in the soil. The temperature gradient of arid soil had a direct influence on circulation of water in the soil. (Blecker-Arizona)
W69-02752

THE EFFECTS OF SOIL MOISTURE STRESS ON THE GROWTH OF BARLEY: IV. THE RESPONSE TO PRESOWING TREATMENT,
Adelaide Univ. (Australia). Waite Inst.
I. Husain, L. H. May, and D. Aspinall.
Aust J Agric Res, Vol 19, No 2, pp 213-220, March 1968. 8 p, 4 tab.

Descriptors: Plant physiology, *Soil moisture, *Barley, *Moisture stress, Germination, Drying, Wetting, *Plant growth, Leaves, Resistivity, Turgidity, Lysimeters, *Crop response, Treatment, Soil-water-plant relationships.
Identifiers: Presowing treatment.

The claim that a presowing treatment, consisting of two cycles of wetting and drying, reduces susceptibility of barley to effects of water stress during growth was investigated. Barley grain was thoroughly mixed with water equivalent to 30% of its air-dry weight. The moistened grain was allowed to germinate in a saturated atmosphere at approximately 20 deg C for 48 hours. The damp grain was then spread out and dried down to its original weight. This cycle was repeated once, the grain being allowed to germinate for 24 hours only on the second occasion. Apart from a 15% increase in grain size on plants subjected to water stress late in development, no persistent effects of treatment were found, and no evidence to support claims of increased yield under water stress conditions. Possible reasons for the evident difference between these data and those of other studies were discussed. (Affleck-Arizona)
W69-02759

EFFECTS OF VERTICALLY HETEROGENOUS SOIL SALINITY ON PLANT GROWTH AND WATER UPTAKE,
California Univ., Riverside.
For primary bibliographic entry see Field 02I.
For abstract, see .
W69-02761

EFFECT OF BARE FALLOW, BARLEY, AND GRASS ON SALINITY OF A SOIL OVER A WATER TABLE,
Fred M. Sandoval, and L. C. Benz.
Soil Sci Soc Amer Proc, Vol 30, No 3, pp 392-396, May-June 1966. 5 p, 4 fig, 6 tab.

Descriptors: *Saline water, *Saline soils, Salinity, *Leaching, *Water table, Fallowing, Precipitation (Atmospheric), Rotations, Evapotranspiration, Evaporation, North Dakota, Barley, Soil moisture, Moisture tension, Groundwater, Soil chemical properties, Grasses, Crop response, Ions.
Identifiers: Perennial grasses.

A study was conducted in North Dakota to compare effects of bare fallow, perennial grass and barley culture on salinity of land affected by a highly saline, shallow water table that ranged in depth from 0.5 to 3 meters. Water levels were usually closest to the surface under fallow, followed by small grain and grass in that order. Salt concentration of the shallow groundwater remained fairly constant as indicated by electrical conductivity. Short-period leaching was more effective under grass than the other treatments. Precipitation in excess of evaporation supplied water for leaching of soluble soil salts under fallow. Under cropping, evapotranspiration left little excess water for leaching. Salinity may increase near the surface when a crop with high evapotranspiration like grass is grown in the presence of a saline shallow water table. Bare fallow in a cropping rotation where weeds are controlled and a shallow soil mulch is maintained on the surface, may have merit in the management of saline nonirrigated soils in arid climates, permitting the use of natural rainfall to reduce salinity in the root zone. (Blecker-Arizona)
W69-02768

2H. Lakes

BOTANICAL AND CHEMICAL CHARACTERISTICS DURING THE FALL OVERTURN OF A SMALL EUTROPHIC LAKE, PRETTY LAKE, INDIANA,
Geological Survey, Fort Wayne, Ind.
Robert G. Lipscomb.
U S Geol Surv Prof Pap 500-B, pp B204-B208, 1966. 6 p, 5 fig, 1 tab, 3 ref.

Descriptors: *Limnology, *Turnover, Eutrophication, Lakes, Indiana, Thermal stratification, Phytoplankton, Cyanophyta, Chlorophyta, Diatoms, Indicator organisms, Hydrogen ion concentration, Hydrogen sulfide, Dissolved oxygen.
Identifiers: Pretty Lake, Glacial lakes, Kettle hole lakes, Aphanizomenon, Asterionella, Fragileria, Cyclotella, Melosira.

Five monthly samples (28 August - 15 December 1963) from a small glacial lake in Indiana show that patterns of phytoplankton distribution, dissolved-oxygen concentration, and pH were in close harmony with thermal stratification of the water and with erasure of the stratification. Algal species belonging to the Chlorophyceae, Baccillariophyceae, and the Myxophyceae were dominant phytoplankton during late stages of the stratification. Author expresses abundance of phytoplankton as percentage concentration. Species of blue-green algae were dominant as 60% of population in August and decreased to a low of 5% after turnover (15 December). Species of green algae continued at rather low levels of abundance throughout the period of study but attained peak abundance (7%) at sampling of 15 November, at which time blue-greens constituted 47% and diatoms, 40%. By mid-December, after erasure of the stratification, the phytoplankton population had increased considerably and was dominated by winter species of diatoms (90%), whereas blue-greens constituted only 5%.
W69-02409

EUTROPHICATION OF WATER RESOURCES OF NEW YORK STATE. A STUDY OF PHYTOPLANKTON AND NUTRIENTS IN LAKES CAYUGA AND SENECA,
New York State Coll. of Agriculture, Ithaca.
Daniel H. Hamilton.
Cornell University Water Resources Center, Publication No. 14, November 1966. 22 pp, 12 tab, 6 fig, 10 ref. OWRR Project A-007-NY.

Descriptors: Nutrients, Eutrophication, Lake stages, Opacity.
Identifiers: Lakes.

The distribution of phytoplankton pigments, nitrates and phosphates in the large deep Cayuga and Seneca Lakes was measured during the summer of 1965. The phytoplankton standing crops indicate that these lakes are now relatively fertile; maximum pigment values were about 20 mgm Chl A per cubic meter. The only parameter aside from temperature that could be compared with earlier studies was transparency, measured by Secchi disc, which showed a very distinct decrease from about 10 M in the earliest measurements about 50 years ago to about 3 M. There is some evidence that transparency may have decreased most rapidly in the last two decades. Nitrate levels are relatively high, but phosphate remains very low, less than 0.5 microgram at. per liter. Possible sources of nutrient enrichment are discussed. (Barlow-Cornell)
W69-02488

CIRCULATION AND MIXING PROCESSES IN LAKES,
Wisconsin Univ., Madison. Water Research Center.
R. A. Ragotzkie, and J. A. Hoopes.
Tech Comp Rept for OWRR Project A-004-Wis, Water Research Center, 1968. 16 p.

Descriptors: Lake Superior, Coriolis force, Infrared radiometry, Wind shear, Lake circulation, Thermal stratification, Seiches, Laboratory models.

Through the combined efforts of this field, laboratory, and theoretical study, quantitative models and data, regarding certain features of the circulation of Lake Superior are known. The most significant result is the tendency for strong and relatively narrow boundary currents to occur along the perimeter of Lake Superior and the other Great Lakes as well. Airborne studies, confirmed by ship and buoy measurements, have shown that the Keweenaw Current (a north-eastward flowing current along the Keweenaw Peninsula) occurs from late June through early October with a velocity of 1 knot. Airborne infrared measurments have also shown the presence of two, large cold cells in the eastern end of the lake. From the theoretical models, the existence of a strong, nearshore, boundary current around the whole Lake is predicted; field observations support this result. Laboratory model studies in a rotating model os the Lake support the field and theoretical observations and provide a physical analog of the Lake circulation.
W69-02489

NOCTURNAL HEAT LOSS OF A LAKE AND SEASONAL VARIATION IN ITS VERTICAL THERMAL STRUCTURE,
Toronto Univ. (Ontario). Dept. of Mathematics.
D. V. Anderson.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 33-40 Sept 1968. 8 p, 4 fig, 12 ref.

Descriptors: *Limnology, *Thermocline, *Water temperature, *Heat budget, *Diurnal, Convection Cooling, Lake Ontario, Thermal stratification Water circulation.
Identifiers: *Nocturnal heat loss, Vertical thermal structure.

A synthetic diurnal energy budget averaged for each month of the year shows that Lake Ontario loses very little heat at night during April, May, and June. The nightly losses during July, August, and September are conjectured to contribute significantly to the deepening of the thermocline through vertical convection. In summary, convection by nocturnal cooling must be considered along with wind mixing as important in controlling the thermal structure of large lakes. (Knapp-USGS)
W69-02507

A CATALOG OF CHEMICAL ANALYSES OF LAKE WATER SAMPLES 1925-1966,
Wisconsin Conservation Dept., Madison. Fish Management Div.
Ronald J. Poff.
Wisconsin Conserv Dep. Fish Manage Div, Feb 6, 1967. 41 p.

Descriptors: *Lakes, *Limnology, *Data collections, *Wisconsin, *Chemical analysis, Eutrophication, Water quality, Water chemistry, Nutrients, Water properties, Soil type, Oligotrophy, Data processing, Data storage and retrieval, Geologic formations, Glaciation, Dolomite.
Identifiers: Upper Cambrian sandstone, Superior sandstone, Pre-Cambrian igneous, Reddish clay loams, Sands, Grayish yellow silt loams, Sandy loams, Grayish brown glaciated silt loams, Grayish brown unglaciated silt loams, Pink loams, Driftless areas, End moraines, Ground moraines, Lake basins, Pitted outwash, Unpitted outwash, Grayish and sandy loams.

From archival sources and current determinations carried out in the laboratories of his own agency, author has assembled a data bank for chemical analyses of 1282 samples from 928 lakes of Wisconsin. Data have been stored, retrieved and printed by electronic data processing techniques. Presentation includes the following items of data: county number, lake identification, date, sample source, data source, specific conductance (micromhos/cm at 25 deg Celsius), pH, total alkalinity (mg/liter as calcium carbonate), CALCIUM, MAGNESIUM, SODIUM, POTASSIUM, TOTAL IRON, ORGANIC Kjeldahl nitrogen, ammonia as nitrogen, nitrate as nitrogen, total phosphate by nitric/perchloric acid digestion, dissolved phosphates, chlorides, and sulphates. in all cases, results are in units of milligrams/liter except where otherwise noted above. Provisions have been made to update the data bank, and author indicates that 300 analyses are on file which have not been incorporated in the presentation. Preliminary analysis of treatment means for 15 items of analyses have been presented for treatment according to geological province (5 categories), glacial province (7 categories), and soil province (9 categories).
W69-02522

PRIMARY PRODUCTION IN LAKES,
Bowling Green State Univ., Ohio. Dept. of Biology.
Jacob Verduin.
Limnol Oceangr, Vol 1, pp 85-91, 1956. 7 p, 2 fig, 2 tab, 17 ref, disc.

Descriptors: *Lakes, *Carbon cycle, *Primary productivity, *Phytoplankton, *Photosynthesis, Limnology, Light penetration, Lake Erie, Instrumentation, Eutrophication, Oligotrophy, Wisconsin, Colorado, Kansas, Pennsylvania, Comparative productivity, Diatoms, Seston, Chlorophyll, Estimating equations.
Identifiers: Helmet Lake (Wis), Trout Lake (Wis), Crystal Lake (Wis), Muskellunge Lake (Wis), Weber Lake (Wis), Nebish Lake (Wis), Scaffold Lake (Wis), Pymatuning Reservoir, Georges Bank, Sandusky Bay, Allens Lake (Colo), Base Line Lake (Colo), Haydens Lake (Colo), Beasly Lake (Colo), Gaynor Lake (Colo), Boulder Lake (Colo), Kossler Lake (Colo), Secchi disk, Autotrophy, Euphotic zone.

Limnological data from the literature and author's research yield mean photosynthetic rates for lacustrine phytoplankton under optimal light (natural conditions) of about 0.5 micromoles (oxygen evolved or carbon dioxide consumed)/microliter of organisms/hour; 1-2 micromoles/milligram ash-free dry weight/hour; and 0.2 micromoles/microgram chlorophyll/hour. For lakes with epilimnetic euphotic zone, equation for estimating daily photosynthesis/square meter of water (Y sub a) is: (Y sub a) = (P sub v) (Y sub p) (D sub 1) (0.65), where (P sub v) = mean phytoplanktonic crop/cubic meter in euphotic zone; (Y sub p) = daily photosynthesis/unit standing crop under optimal light; (D sub 1)= depth of euphotic zone. For lakes with hypolimnetic euphotic zone or where bottom receives more than 1% of surface light, equation is: (Y sub a) = (P prime sub v) (Y sub p) (D sub 2); where (P prime sub v) = mean phytoplanktonic crop in epilimnion; (D sub 2) = depth to midthermocline or to bottom in unstratified lakes. For seven Wisconsin lakes, yields (millimoles/sq meter/day) calculated from these equations range from 56 (Trout L) to 325 (Scaffold L), compared with range of 47 (Helmet L) to 146 (Scaffold L) estimated by more tedious method described elsewhere in literature. Ten similar computations for waters of Kansas, Colorado, and L Erie yielded mean value of 196.Q, with range 122 (Kossler L, Colo) to 450 (Gaynor L, Colo).
W69-02523

THE USE OF RIBONUCLEIC ACID IN ZOOPLANKTON AS AN INDEX OF BIOLOGICAL PRODUCTIVITY IN FRESH WATER LAKES,
Wisconsin Univ., Madison. Dept. of Zoology.
John S. Bjerke.
MS Thesis, 1962. 80 p.

Descriptors: *Lakes, *Zooplankton, *Secondary productivity, Comparative productivity, Daphnia, Biological productivity, Wisconsin, Bioindicators, Analytical techniques, Trophic level, Eutrophication, Oligotrophy, Growth stages, Proteins, Metabolism, Bioassay.
Identifiers: *Productivity indices, Lake Mendota (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Mary (Wis), Pine Lake (Wis), Stewart's Dark Lake (Wis), Little John Lake (Wis), Erickson Lake (Wis), Trout Lake (Wis), Allequash Lake (Wis), Cather Lake (Wis), Nucleic acid, Ribonucleic acid, Daphnia schodleri.

Author presents modification of a previously described method for estimating ribonucleic acid ribose by the orcinol reaction, making possible the estimation of ribonucleic acid (RNA) for as few as 50 Daphnia. Content of RNA (expressed as percentage of dry weight) decreases as Daphnia grows. RNA content decreases from 10.33%, for animals with mean length of 1.0 mm and mean weight of 5.4 micrograms, to 4.31%, for those with mean length of 2.24 mm and mean weight of 26.2 micrograms. Contents of brood pouch also influence RNA content. Two samples each of following types yielded the following results: empty brood pouch, 5.79%; eggs in pouch, 4.82%; with embryos, 7.01%; and with nauplii, 6.32%. A total of 58 samples, from 11 Wisconsin lakes representing a variety of trophic types, were analyzed. For 5 samples from eutrophic Lake Mendota, RNA content increased for all size classes during the period, June - October 1961. If RNA content is interpreted as indicative of rate of protein synthesis, author asserts that his data are compatible with hypothesis that such analyses may be used as assay for biological production. He stresses the need for further research.
W69-02524

PRELIMINARY WATER BALANCE STUDIES OF THE ROTORUA LAKES,
Ministry of Works, Hamilton (New Zealand).
R. J. Pittams.
J of Hydrol (New Zealand), Vol 7, No 1, pp 24-37, 1968. 14 p, 2 fig, 5 tab, 3 ref.

Descriptors: *Water balance, *Lake basins, Lakes, Seepage, Rainfall, Evapotranspiration, Limnology, Outlets.
Identifiers: *Lake level changes, *Outflows, Groundwater storage, New Zealand, Rotorua Lakes.

Rainfall, evapotranspiration, groundwater storage, outflow, and lake levels for Lakes Rotoma, Rotoehu, Rotorua, and Rotoiti, in the Rotorua-Bay of Plenty area of the North Island of New Zealand was studied quantitatively. All basic relationships were investigated using data from Lake Rotoma, and the annual water balances for the various lakes are compared with data on Lake Rotoma. This study is of interest since it involves lakes with no open outlet (Lake Rotoma, and Rotoehu), water loss through seepage and underground flow, and the response of lake levels to rainfall. Pertinent tabular data accompany an exposition of the study results. (Llaverias-USGS)
W69-02675

THE USE OF OXYGEN 18 AND DEUTERIUM CONCENTRATIONS IN THE WATER BALANCE OF LAKES,
International Atomic Energy Agency, Vienna (Austria).
T. Dincer.
Water Resources Res, Vol 4, No 6, pp 1289-1306, December 1968. 18 p, 9 fig, 8 tab, 27 ref.

Descriptors: *Deuterium, *Oxygen, *Tracers, *Lakes, *Water balance, Evaporation, Precipitation (Atmospheric), Hydrologic budget, Inflow.
Identifiers: Turkey, Oxygen isotopes.

Natural concentrations of stable isotopes of hydrogen and oxygen are used to determine the water balance of lakes situated in a subhumid climate in southwestern Turkey. A salt lake in that region is used as an index to the molecular exchange process between the lake and the atmospheric moisture. Such use of stable isotopes of oxygen and hydrogen in water balance studies appears to yield promising results and indicates that environmental isotopic studies might be a useful tool in limnological studies. Oxygen-18 is plotted against deuterium in precipitation, spring, and lake samples in the Antalya-Konya regions. Isotopic compositions of the lakes are tabulated and mapped.
W69-02685

LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT,
Arizona Univ., Tucson. Cooperative Fishery Unit.
William J. McConnell.
Limnol and Oceanogr, Vol 13, No 2, pp 343-349, April 1968. 7 p, 1 fig, 4 tab, 16 ref.

Descriptors: *Limnology, *Aquatic productivity, *Fish, *Nutrients, *Leaves, Leaching, Oak trees.
Identifiers: Pena Blanca Lake (Arizona).

Watershed litter in semiarid southeastern Arizona is relatively unleached, and the accumulation of a year or more is occasionally delivered to lakes within the first few days of the summer rainy season. Pena Blanca Lake received at least 750 g/sq m of oak litter during the summer of 1959. About 329 kg cal/sq m were delivered to the lake in oak litter extracts of which 26% were probably from carbohydrates, 54% from phenolic compounds, and 20% from unidentified compounds. Oak leaf extracts were experimentally effective as an energy source for microorganisms used as food by filter-feeding organisms (Xenopus laevis) and snails. Efficiency of the extract-microorganisms-Xenopus and snail food chain was 3.28%. Based on an estimated ecological efficiency of 0.56% for the food chain: litter extract-microorganisms-zooplankton-young Micropterus salmoides, Micropterus biomass production may have been increased 0.4 g/sq m to the second power by organic components in oak litter extracts contributed to Pena Blanca Lake in 1959. This increase represents 16.7% of the average annual fish harvest for 1959, 1960, and 1961.
W69-02687

LAKE ERIE REPORT: A PLAN FOR WATER POLLUTION CONTROL,
Federal Water Pollution Control Administration, Washington, D. C.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-02695

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THE SEASONAL VARIATION OF PHOSPHATE, SILICATE, AND NITRATE IN WATERS OF THE ENGLISH LAKE DISTRICT,
Freshwater Biological Association, Ambleside (England).
J. Heron.
Limnol Oceanogr, Vol 6, pp 338-346, 1961. 9 p, 5 fig, 10 ref.

Descriptors: *Eutrophication, *Phosphates, *Silicates, *Nitrates, *Nutrients, *Water pollutions sources, *Water pollution effects, Diatoms, Spectrophotometry, Water quality, Water chemistry, Agricultural chemicals, Agricultural watersheds, Analytical techniques, Mud-water interfaces.
Identifiers: Melosira English Lake District, Lake Windermere, Esthwaite Water, Blelham Tarn, Asterionella.

Author publishes data for rainfall; temperature, at surface and bottom; total diatom population; and changes in concentration of nitrate-nitrogen, phosphate-phosphorus, and silicon, derived from weekly sampling of four basins (north and south basins of Lake Windermere, Esthwaite Water, Blelham Tarn) of the English Lake District from January 1958 to March 1960. A more sensitive analysis for phosphate is described. Chemical water quality of the lakes are influenced by geological characteristics of the drainage basin and by relationship of the basins, one to the other. Total ionic concentration for north basin of Windermere averages 0.51 milli-equivalents/liter; for south basin, 0.55; for Esthwaite Water, 0.75; and for Blelham Tarn, 0.80. Graphs indicate a marked correlation between rainfall and increase in phosphate concentrations in surface water. Author asserts that, as a source of phosphate, exchange at the mud-water interface is greatly outweighed in importance by application of fertilizers to agricultural land in the drainage basin. Increased concentrations of phosphate during summer months may result from temporary enrichment due to heavy rainfall, release of phosphate from algal cells after blooms, and contamination by zooplankton excreta. Erratic temporal variations of nitrate are described but not explained.
W69-02786

THE SEASONAL AND DIEL CHANGES IN DISTRIBUTION OF DIAPTOMUS LEPTOPUS IN A SMALL EUTROPHIC LAKE,
British Columbia Univ., Vancouver. Dept. of Zoology.
M. C. Healey.
Limnol Oceanogr, Vol XII, No 1, Jan 1967. 6 p, 1 fig, 4 tab, 11 ref.

Descriptors: *Eutrophication, *Indicator organisms, *Copepods, *Vertical migration, Lakes, Limnology, Seasonal, Diurnal, Distribution, Distribution patters, Behavior, Animal behavior, Variability, Sampling, Digital computers, Computer programs, Growth stages, Diel migration.
Identifiers: Lake Corbet (B C), British Columbia (Canada), Diaptomus leptopus, Clarke-Bumpus sampler, Aggregation, Fisher's coefficient of dispersion, Analysis of variance, Wisconsin net.

Studied during June-September 1963, populations of Diaptomus leptopus in eutrophic Corbet Lake, British Columbia, displayed differences in migratory behavior among age groups. Populations of the copepod were sampled monthly with a Clarke-Bumpus sampler from 13 depths at a single station. In addition, a series of vertical hauls with a Wisconsin net (No 10 mesh) were made at several widely spaced stations. Samples so collected were counted by groups as juveniles (stages I-IV) and adult males and females (stages V-VI). Resultant numbers were subjected to a three-way analysis of variance (depth by month by time of day). Fisher's dispersion coefficient (sample variance/sample mean) was used as an index of degree of vertical and horizontal aggregation (clumping). Only adult males showed significant vertical migration. Adult females and juveniles demonstrated diel changes in vertical migration, but not consistently between samples. All three groups were significantly clumped vertically, and the data suggest that such clumping is related to population size. There was some evidence for horizontal patchiness. Author emphasizes the possibility that ontogenetic changes in migratory behavior provide new clues to the biological significance of vertical migration.
W69-02789

NITROGEN FIXATION AND THE UTILIZATION OF OTHER INORGANIC NITROGEN SOURCES IN A SUBARCTIC LAKE,
Alaska Univ., College, Inst. of Marine Science.
Vera A. Billaud.
J. Fish. Res. Bd. Canada, Vol 25, No 10, pp 263-269, October 1968. 10 p, 5 fig, 18 ref.

Descriptors: *Nitrogen cycle, *Nitrogen fixation, Subarctic, Limnology, Alaska, Ammonia, Nitrates, Stable isotopes, Ammonification, Nitrification, Denitrification, Anaerobic conditions.
Identifiers: Nitrogen utilization.

The relative nutritional importance of ammonia, nitrate and molecular nitrogen in a subarctic lake was investigated using the stable isotope nitrogen-15 as a tool to determine uptake ratios. These data were correlated with the chlorophyll, particulate nitrogen and phytoplankton organisms present on a year-round basis. Quantitative determinations of nitrogen nutrient concentrations were also carried out. Ammonia was consistently the most important nitrogen source, and of the two main algal production periods, the first early spring population under ice depended exclusively on this source. The second spring population, dominated by Anabaena flos-aquae, used ammonia, nitrate, and molecular nitrogen simultaneously. During much of the summer, low uptake ratios prevailed with ammonia the principle source, although during the fall nitrate uptake briefly approached the magnitude of ammonia uptake.
W69-02795

VERTICAL CURRENT STRUCTURE IN THE GREAT LAKES,
Michigan Univ., Ann Arbor.
Vincent E. Noble, Joseph C. Huang, and James H. Saylor.
Special Report No. 37, Great Lakes Research Division, University of Michigan, 1968, 94 p. FWPCA Grant WP-01067.

Descriptors: Lake Michigan, Convection, Water circulation, Eddies, Diffusion, Water currents, Great Lakes, Stratification, Thermal properties.

During a two-year program to study the three-dimensional structure of the currents of Lake Michigan, experiments have been carried out to describe the circulation dynamics of Lake Michigan. Two closely-spaced current meter station records have been compared with local wind data and have shown that there is not a simple response of the currents to the wind field. Aerial thermal surveys of the total lake basin, when compared with BT transects have indicated a large-scale, seasonal circulation pattern in the lake basin. Theoretical models of the spring warming period of the lake predict circulation patterns that are consistent with field measurements, and that indicate that thermal, geostrophic forces may define the basic circulations of the lake. Additional consideration of Stern's model of the effects of wind on geostrophic vortices supports the hypothesis that the effect of wind stress upon the lake basin is a perturbation of the geostrophic circulation field, particularly in the spring and fall of the year.
W69-02797

2I. Water in Plants

SALT ENTRY INTO PLANTS,
Agricultural Research Service, Beltsville, Md. Mineral Nutrition Lab.
Sterling B. Hendricks.
Soil Sci Soc Amer Proc, Vol 30, No 1, pp 1-7, January-February 1966. 7 p, 8 fig, 38 ref.

Descriptors: Metabolism, Saline soils, *Translocation, *Root systems, *Salts, Soil-water-plant relationships, Hydrogen ion concentration, *Cytological studies, Absorption, Plant morphology, Plant tissues, Infiltration, Ions, Anion exchange, Equilibrium, Cation exchange.
Identifiers: Salt entry, Salt transport.

The manner of salt entry into roots and salt transport within the plant were discussed in this paper. The plasmalemma was a major barrier preserving integrity of the cell, serving to limit leakage of salts, sugars, acids and other materials from plants to water. The exceedingly quick response of salt uptake to changes in external conditions such as pH and the action of inhibitors indicated that the plasmalemma of epidermal cells was the chief barrier to salt passage. If the coupling of substrate oxidation to molecular oxygen was inhibited, adenosine triphosphate (ATP) production and salt uptake by the root were proportionately inhibited. A scheme for salt transport through the plasmalemma was shown. Salt not only entered the root but moved from the root to the soil solution. The distinction made by the plant between potassium and sodium was discussed. In salt accumulation, transport from the roots was limited, an eventual equilibrium was reached with equal efflux and influx rates. (Blecker-Arizona)
W69-02747

NITROGEN FERTILIZER AND WHEAT IN SEMI-ARID ENVIRONMENT 2. CLIMATIC FACTORS AFFECTING RESPONSE,
Commonwealth Scientific and Industrial Research Organization, Brisbane (Australia). Cunningham Lab.
J. S. Russell.
Aust Jour Exp Agr and Animal Husb, Vol 8, No 3, pp 223-231, April 1968. 9 p, 4 tab.

Descriptors: *Climatic data, *Nitrogen, *Fertilizers, Wheat, Semiarid climates, Temperature, *Regression analysis, Rainfall, Variability, Monthly, Diurnal, Evaporation, *Crop response.

A study was conducted of climatic factors influencing the yield response of wheat to nitrogen fertilizer in semi-arid areas of South Australia. The dependent variables were linear and quadratic coefficients obtained by fitting orthogonal polynomials to the response curves of various parameters to nitrogen fertilizer in 52 experiments during 19[illegible] 1961. Independent variables were the following climatic characteristics: daily rainfall, evaporation and temperature. Relationships between these dependent and independent variables were examined by multiple regression analysis. Climatic factors contributed significantly to the regression of linear and quadratic coefficients examined. Positive effects of increasing amounts of rainfall on yield response during the preheading period were evident. On the other hand, the negative effects of high temperatures in the latter part of the growing season were also marked. The final response appears to be the resultant of these two main effects. (Affleck-Arizona)
W69-02748

EFFECT OF RESTRICTED ACCESS TO WATER ON THE INTAKE OF SALTY FOOD BY MERINO AND BORDER LEICESTER SHEEP,
Commonwealth Scientific and Industrial Research Organization, Riverina (Australia). Riverina Lab.
A. D. Wilson, and N. L. Hindley.
Aust J Agric Res, Vol 19, No 4, pp 597-604, 1968. 8 p, 1 fig, 5 tab.

Descriptors: *Sheep, *Sodium chloride, *Digestion, Water requirements, Animal physiology, Moisture stress, Semiarid climates, *Urine, Food, Feeding rates, *Water balance.
Identifiers: *Saltbush (Australia), *Restricted access, *Water intake.

study was conducted in Australia in which sheep ere fed on diets containing 7.5, 11.25, and 15% dded sodium chloride to simulate diets containing p to 100% saltbush (Atriplex sp). All experiments ere conducted indoors in the cool weather so that hanges in water intake were attributable to the eatments imposed. There was a reduction in food ntake when access to water was restricted to once aily, the reduction being more severe with the ore salty diets. Merino sheep drank 5.0 l/day and order Leicester sheep drank 7.6 l/day when fed n the diet containing 15% sodium chloride and hen their access to water was restricted to once aily. The Border Leicesters ate 22% more food an the Merinos. It was concluded that Merino eep will need to drink more often than once daily hen their water intake exceeds 5 l/sheep/day, and at this would occur when the saltbush intake eached 500-600 g/day. (Affleck-Arizona)
69-02750

HE NATURE OF THE PERENNIAL ESPONSE IN MEDITERRANEAN GRASSES: . SENESCENCE, SUMMER DORMANCY, AND URVIVAL IN PHALARIS,
ommonwealth Scientific and Industrial Research rganization, Canberra (Australia). Div. of Plant dustry.
R. McWilliam.
ust J Agric Res, Vol 19, No 3, pp 397-409, May 968. 13 p, 4 fig, 2 tab.

escriptors: *Grasses, *Crop response, Drought sistance, Summer, *Life cycles, Plant growth, Moisture stress, Root systems, *Photosynthesis, ant physiology, Carbon cycle, Translocation, rowth stages.
entifiers: Perennial grasses, Annual grasses, Senescence, *Dormancy, *Buds.

daptation to summer drought has been one of the ajor factors influencing the life cycle of the editerranean grasses. A study was made of the enomena of senescence and bud dormancy, and e fixation and movement of carbon assimilates der simulated conditions of a summer drought. A pical perennial, Phalaris tuberosa, was compared th a closely related annual species, P minor. One the most important factors controlling the plant rvival of these two species was the difference in e rate and pattern of senescence after flowering der the influence of moisture stress. In the an- al, senescence was rapid and complete, but in e perennial it was retarded, and function was tained in certain organs, including the lower stem d root system, throughout the summer stress. is permitted survival of dormant buds which ntained the meristems vital for regrowth in the tumn. (Affleck-Arizona)
69-02754

HE NATURE OF THE PERENNIAL ESPONSE IN MEDITERRANEAN GRASSES: I. ATER RELATIONS AND SUMMER SUR- VAL IN PHALARIS,
ke Univ., Durham, N. C. Dept. of Botany.
R. McWilliam, and P. J. Kramer.
ust J Agric Res, Vol 19, No 3, pp 381-395, May 68. 15 p, 6 fig, 2 tab.

escriptors: Arid climates, Nutrients, Water lance, *Grasses, Drought tolerance, Soil oisture, Soil-water-plant relationships, *Root tems, Water loss, *Crop response, *Moisture ess, Plant physiology, On-site investigations, Ab- rption, *Summer, Transpiration, Plant growth, lting point.
entifiers: Perennial grasses, Annual grasses, rmancy, Stems.

e water relations of a typical mediterranean rennial grass, Phalaris tuberosa L, were studied th in the field and in a controlled environment der conditions of a simulated summer drought. It s found that an important factor in the survival this perennial was the ability of its deep root tem to supply water during the summer to the rmant culms at the soil surface. In contrast the related annual P minor was unable to exploit subsoil moisture and died as soon as the surface moisture was exhausted. During the summer stress the volume of water supplied by the perennial roots was sufficient to offset transpiration losses and maintain a favorable water balance in the dormant culms. Roots of the perennial were followed to a depth of 7 feet in subsoil containing available moisture. The large metaxylem vessels and heavily suberized endodermis of the roots suggested that they were well adapted to transporting water up through the dry surface soil to the base of the dormant culms. (Affleck-Arizona)
W69-02755

STUDIES ON SALT TOLERANCE OF SHEEP: VII. THE TOLERANCE OF EWES AND THEIR LAMBS IN PENS FOR DRINKING WATERS OF THE TYPES OBTAINED FROM UNDERGROUND SOURCES IN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Nutritional Biochemistry.
A. W. Pierce.
Aust J Agric Res, Vol 19, No 4, pp 577-587, July 1968. 11 p, 2 fig, 6 tab.

Descriptors: *Sheep, Saline water, *Salts, Animal physiology, *Salt tolerance, Reproduction, Bicarbonates, Chlorides, Diets, Electrolytes, *Potable water, *Groundwater, Water requirements, Weight, Ions.

A study was conducted in Australia in which groups of eight or ten ewes were offered various solutions as drinking waters. In two experiments these comprised: (1) reservoir water (control group); (2) synthetic water containing salts in proportions found in many underground waters in South and Western Australia (chloride water) with a total salt concentration of 1.30%; or (3) synthetic water resembling the waters obtained in Queensland from the Great Artesian Basin (bicarbonate water) with a total salt concentration of 0.50%. In a third experiment the total concentration of salts in the chloride water was only 1.00% that of the bicarbonate water again being 0.50%. The intake of saline waters in all experiments was higher than that of reservoir water, the increases ranging from 20 to 50%. No adverse effects were observed on health, food consumption, or wool production of the ewes and lambs as a result of drinking any of the saline waters. (Affleck-Arizona)
W69-02756

THE EFFECTS OF SOIL MOISTURE STRESS ON THE GROWTH OF BARLEY: IV. THE RESPONSE TO PRESOWING TREATMENT,
Adelaide Univ. (Australia). Waite Inst.
For primary bibliographic entry see Field 02G.
For abstract, see .
W69-02759

INFLUENCE OF CALCIUM PRETREATMENT ON WHEAT GERMINATION ON SALINE MEDIA,
Utah State Univ., Logan. Dept. of Botany.
I. I. Chaudhuri, and H. H. Wiebe.
Plant and Soil, Vol 28, No 2, pp 208-216, April 1968. 9 p, 2 fig, 6 tab.

Descriptors: *Wheat, Saline soils, *Seeds, *Germination, Crop response, Absorption, Osmotic pressure, *Calcium, *Salt tolerance, Sodium chloride, Chlorides.
Identifiers: *Pre-treatment (Plants).

It was found that wheat seeds pretreated with calcium salts induced significant increases in germination on high sodium chloride media. An investigation was conducted to study the characteristics of this salt resistance, and to devise the best pretreatments to induce salt resistance at the germination stage. Germination of water pretreated seeds on 1% NaCl was 8 percent, while pretreatment with 1% CaCl sub 2.2H sub 2 O resulted in 90 percent germination on 1% NaCl. Pretreatment with sodium and potassium chlorides enhanced germination only slightly. Pretreatment concentrations ranging from 1 to 5% CaCl sub 2.2H sub 2 O, and times ranging from 3 to 24 hours were about equally effective. Pretreatment with calcium resulted in about a 25 percent reduction in Na super 22 uptake from the germination medium. (Affleck-Arizona)
W69-02760

EFFECTS OF VERTICALLY HETEROGENOUS SOIL SALINITY ON PLANT GROWTH AND WATER UPTAKE,
California Univ., Riverside.
J. Shalhevet, and L. Bernstein.
Soil Sci, Vol 106, No 2, pp 85-93, Aug 1968. 9 p, 5 fig, 2 tab.

Descriptors: *Saline soils, *Alfalfa, *Root systems, Equations, Growth chambers, *Crop response, Osmosis, Salt tolerance, Irrigation effects, *Moisture uptake, Absorption, On-site data collections, Soil-water-plant relationships, Root zone, Water utilization.

By means of a root-compartment technique, the effect of non-uniform distribution of salts in the soil on alfalfa growth and water uptake was studied at Riverside, California. The root system was divided by a horizontal wax membrane into two equal depth sections. Each chamber was salinized and irrigated separately through a wick distribution system. It was found that mean salinity of the root zone was a good estimate o effective salinity and that the salinity of both chambers was equally significant in causing yield reductions. Water uptake from each chamber was strongly influenced by salinity of both chambers. It decreased as salinity of the chamber increased and increased at about half the rate as salinity of the complementary chamber increased. Total plant water potentials were also computed from water-uptake rates and soil-water potentials, using linear-flow equations. (Affleck-Arizona)
W69-02761

SOME EFFECTS OF WATER RESTRICTION ON APPARENT DIGESTIBILITY AND WATER EXCRETION OF CATTLE,
Western Australia Univ., Nedlands (Australia). Inst. of Agriculture.
R. F. Thornton, and N. G. Yates.
Aust J Agric Res, Vol 19, No 4, pp 665-672, July 1968. 8 p, 2 fig, 4 tab, 27 ref.

Descriptors: *Cattle, Animal physiology, *Moisture stress, Water balance, *Digestion, Feeding rates, *Urine, Animal metabolism, Water requirements.
Identifiers: Australia, Dry matter, *Excretion, *Water restriction.

An experiment was conducted in Australia to investigate the influence of restricting water intake on dry matter intake, nutrient digestibility, and water excretion of cattle. The interrelationships between these variables and the likely physiological significance of the findings were discussed. During water restriction: (1) Increased dry matter and acid detergent fibre digestibilities could not be wholly accounted for by decreased intake of dry matter. (2) Reduced faecal water output was more important than changes in urine output in conserving water. It was suggested that the hind gut has a regulatory role in the observed responses to water restriction. (Affleck-Arizona)
W69-02763

2J. Erosion and Sedimentation

SEDIMENT TRANSPORT IN CONVEYANCE SYSTEMS (PART 2), THE MODES OF SEDI-

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MENT TRANSPORT AND THEIR RELATED BED FORMS IN CONVEYANCE SYSTEMS,
Middle East Technical Univ., Ankara (Turkey); and Lehigh Univ., Bethlehem, Pa.
Ertan R. Acaroglu, and Walter H. Graf.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 123-135, Sept 1968. 13 p, 4 fig, 1 tab, 13 ref.

Descriptors: *Sediment transport, *Conveyance structures, *Sand waves, *Suspension, *Bed load, Reynolds number, Model studies, Regime, Flumes, Prediction, Particle size.
Identifiers: *Bed forms.

Functional relationships between shear intensity and particle Reynolds number are determined using data available from sediment transport model studies. All the data used are plotted. It can be seen from the plot that there are 3 major transport modes. At low flow intensities the major mode is bed load, characterized by ripple and dune movement. At higher intensities the bed has a planar shape, more particles are in suspension, but bed load is still dominant. At high intensities the predominant mode of transport is suspension. In free surface flows, the bed form is antidunes, while in closed conduits, a 'sliding bed' is observed. For each of these modes a function relating intensity and Reynolds number is listed. (Knapp-USGS)
W69-02501

A THERMODYNAMIC ANALOGY FOR TRANSPORT PROCESSES INVOLVING A NON-POSITIVE DEFINITE TRANSPORTED QUANTITY,
Illinois Univ., Urbana.
C. L. Chung, and A. E. Scheidegger.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 88-94, Sept 1968. 7 p, 1 fig, 4 ref.

Descriptors: *Sediment transport, *Thermodynamic behavior, Meanders, Mathematical studies, Energy.
Identifiers: Transport-thermodynamic analogy.

The sediment transport process may be treated analogously to thermodynamic processes, based on the idea that the transported quantity plays the same role as energy. This works only if transport is a non-negative definite quantity like energy. Some functions, such as momentum, may have non-positive values and are also of interest in transport studies. An extension of the thermodynamic analogy to include analysis of non-positive definite quantities is presented. (Knapp-USGS)
W69-02503

SEDIMENT DISTRIBUTION IN TURBULENT FLOW,
Universidad Central de Venezuela, Caracas.
Konstantin Zagustin.
J Hydraul Res, Vol 6, No 2, pp 163-172, 1968. 10 p, 5 fig, 5 ref.

Descriptors: *Sediment concentration, *Sediment transport, Sediments, Sedimentation, *Turbulent flow, Hydraulics, Suspended sediments, Foreign research, Mathematical analysis, Differential equations, Experimental data, *Sediment distribution, Hydrology.
Identifiers: Prandtl-Von Karman equation, Mixing length, Venezuela.

An analytical expression is derived for determining sediment concentration in turbulent flow. Solution is based upon an expression for kinematic eddy viscosity and coincides with experimental points throughout the whole flow region. The agreement of experimental data with theoretical curves is acceptable, with the value of a parameter z (sediment terminal settling velocity divided by the product of a numerical constant, the Von Karman constant, and the shear velocity) being of lower magnitude than obtained with previous theories. The method affords improved predictions of sediment distribution. Obtaining the finite value of sediment concentration at the flow surface is of particular interest. Although the shape of the curves is similar to those previously developed, the difference in magnitude of the parameter z and the concentration at the free surface explain certain phenomena and provide a better framework to present and analyze sediment transport data. (USBR)
W69-02564

THE SEDIMENT YIELD OF MAJOR RIVERS OF THE WORLD,
Soil Conservation Service, Hyattsville, Md.
John N. Holeman.
Water Resour Res, Vol 4, No 4, pp 737-747, Aug 1968. 11 p, 7 tab, 30 ref.

Descriptors: *Sediments, *Sediment yield, *Rivers, Sedimentation, Soil erosion, Sediment transport, Suspended sediments, Bibliographies, Data collections, Erosion, Hydrology, United States.
Identifiers: *Worldwide.

The amount of suspended sediment transported by rivers to the seas each year is tabulated. Major rivers are ranked in order of tons of sediment transported per year; drainage area and water discharge data are included. Rivers are listed by continents, in subsequent tables, with data on drainage area, annual sediment yields in tons, sediment production rates in tons per square mile per year, the years of sediment measurement, and sources of data. This sample represents more than one-third of the land contributing waterborne sediment to the seas and, if representative, indicates an annual world sediment yield of 20 billion tons. Data suggest that Africa, Europe, and Australia have very low sediment yields (less than 120 tons per square mile per year), South Americs's rate is low, North America's is moderate, and Asia's is high to the degree of yielding up to 80% of the sediment reaching the seas annually. (USBR)
W69-02568

A LAG-DEVIATION METHOD FOR ANALYZING CHANNEL BED FORMS,
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.
Joe C. Willis.
Water Resources Res, Vol 4, No 6, pp 1329-1334, December 1968. 6 p, 3 fig, 1 tab, 9 ref.

Descriptors: *Alluvial channels, *Channel morphology, *Bed load, Dunes, Sand waves, Fourier analysis, Numerical analysis.

A simple method for analyzing alluvial channel bed forms for length and time scales can be applied to records of bed elevation with either distance along the channel or time as moving bed forms pass a channel section. The difficulty of obtaining distance records of bed-form elevation in the field is lessened by the use of simultaneous time records from two closely spaced points along the channel. Analysis of these dual records provides the dune period and propagation speed from which the dune length may be derived and permits an estimate of the 'dune load,' the average contribution of the moving bed forms to the bed material transport rate.
W69-02670

DEPOSITION OF SUSPENDED PARTICLES IN A GRAVEL BED,
California Univ., Berkeley.
H. A. Einstein.
ASCE Proc, J of Hydraul Div, Vol 94, No Hy5, Pap 6102, pp 1197-1205, Sept 1968. 9 p, 2 tab.

Descriptors: *Suspended load, *Bed load, *Deposition (Sediments), Gravels, Settling velocity, Particle size, Silts, Pores, Suspended load, Model studies, Flumes.
Identifiers: Experimental results, Particle distribution.

A model of silt flowing in suspension over a gravel bed was studied to learn the mechanism of deposition of silt in the interstices of the bed load. Silt was observed to settle through the gravel and fill pore space from the bottom up. The surface remained clean. No horizontal motion of silt relative to the gravel was observed below the gravel bed surface. The probability of deposition is proportional to silt particle availability. The suspension half life is proportional to water depth and inversely proportional to the silt settling velocity. Basic data are tabulated. (Knapp-USGS)
W69-02690

2K. Chemical Processes

NUTRIENTS LIMITING THE PRODUCTION OF PHYTOPLANKTON IN THE SARGASSO SEA, WITH SPECIAL REFERENCE TO IRON,
Bermuda Biological Station, Saint George's West; and Woods Hole Oceanographic Institution, Mass.
D. W. Menzel, and J. H. Ryther.
Deep-Sea Res, Vol 7, pp 276-281, 1961. 6 p, 6 tab, 10 ref.

Descriptors: *Nutrients, *Primary productivity, *Cycling nutrients, *Iron, Tropical regions, Phytoplankton, Trace elements, Nitrogen compounds, Phosphorus compounds, Photosynthesis, Limiting Factors, Vitamins, Cobalt, Copper, Manganese, Metals, Molybdenum, Oceanography.
Identifiers: Sargasso Sea, Tropical seas, Semi-tropical seas, Bermuda, West Indies, Western Atlantic, Zinc.

Concentrations of nitrate-nitrogen and phosphate-phosphorus commonly found in surface waters of the Sargasso Sea theoretically could support populations of phytoplankton 3-10 times greater than those actually found. Authors studied the problem by determining the photosynthetic rate (expressed as uptake of carbon-14 after 4-hr incubation) of resident phytoplankters 24 and 72 hours after enrichment of surface waters with nitrate, phosphate, vitamins, and trace metals (separately or in combination). Addition of trace metals, the active component of which was found to be iron, enhanced photosynthesis several-fold over unenriched controls. Nitrate, phosphate, and vitamins, added alone or in combination, had little effect on photosynthesis determined after 24 hours. However, 72 hours after enrichment with tract metals, nitrate, and phosphate, uptake, relative to unenriched controls, was enhanced by 11.5-16.1 (5 experiments); whereas trace metals alone gave relative uptakes of 1.0-1.3 (3 experiments), and nitrate-phosphate alone gave 0.8-1.5 (5 experiments). With sufficient iron present, naturally occurring concentrations of nitrate and phosphate became limiting after 24-72 hours' incubation. For samples from 12 stations between Bermuda and the West Indies, enrichment with nitrate-phosphate and nitrate-phosphate-iron resulted in relative uptakes of 1.4 and 4.4 respectively, indicating that the effect is general for semi-tropical seas.
W69-02787

2L. Estuaries

PROCEEDINGS SYMPOSIUM ON HYDROLOGY OF THE COASTAL WATERS OF NORTH CAROLINA.
North Carolina Univ., Chapel Hill.

Report No. 5, Water Resources Research Institute of the University of North Carolina, May 12, 1967. 155 pp. OWRR Project A-999-NC.

Descriptors: *Hydrology, *Groundwater, *Estuaries, Hydrodynamics, Hydrologic data, *North Carolina, *Hydrography, Petrology, Mathematical models.

This Proceedings of a Symposium on Hydrology of the Coastal Waters of North Carolina includes papers related to current research and investigations dealing with ground water and estuarine hydrology in the Coastal Region of North Carolina. Subject matter includes petrology of the Castle

yne Formation, salt water encroachment, ɔphysical techniques, ground water problems of coastal plain, estuary hydrodynamics, estuary w patterns, hydrography and hydrology. owells-No Carolina)
59-02487

LTA-SUISUN BAY WATER QUALITY AND DRAULIC STUDY,
n Francisco Bay District, Vallejo, Calif. Dept. of ater Resources.
arles A. McCullough, and Jerry D. Vayder.
CE Proc, J Sanit Eng Div, Vol 94, No SA 5, Pap 43, pp 809-827, Oct 1968. 19 p, 6 fig, 5 tab, 2

scriptors: *Water quality, *Estuaries, *Californ-, *Saline water intrusion, *Mathematical dels, Farm wastes, Water pollution sources, ncers, Model studies, Laboratory tests, Digital nputers, Computer models, Biochemical oxygen nand.
ntifiers: San Francisco Bay, Suisun Bay.

sent water quality throughout the Sacramento-Joaquin Delta and Suisun Bay in California was ermined. Sources and amounts of wastes which ld cause water-quality degradation were ex-ined to evaluate present and future effects on eiving waters. Findings showed degradation of er quality to be caused by natural and manmade ocesses, including the life cycles of aquatic or-isms, land-surface runoff, sediment transport by h water flows, biochemical cycles, and highly neralized surface or ground waters. Fluorescent -tracer studies were conducted, using the proto-e and a hydraulic model to investigate travel and idence time, flow distribution and circulation terns, mixing and dispersion characteristics and estimate changes in constituent concentrations ulting from future discharge of municipal, indus-l, and agricultural wastes. A mathematical del was used to simulate the hydraulic charac-stics of the Delta, the solution of the model pro-m by digital computer provided the hydraulic ameters for anticipated future flow conditions. ntrol of water quality by low flow augmentation prevent deep saline intrusion and to dilute eamflow is recommended. (Knapp-USGS)
59-02493

YGEN DEMAND AND OXYGEN DEPLE-ON CAPACITY OF SEDIMENTS FROM WAS-W SOUND, GEORGIA,
orgia Univ., Athens.
primary bibliographic entry see Field 05C.
abstract, see .
59-02673

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

RROSION OF METALS IN DESALINATION VIRONMENTS,
w Chemical Co., Freeport, Tex.; and Office of ine Water, Washington, D. C.
primary bibliographic entry see Field 08G.
abstract, see .
59-02582

ANSPORT OF ELECTROLYTES THROUGH EMBRANE SYSTEMS,
uthern Research Inst., Birmingham, Ala.
primary bibliographic entry see Field 05F.
abstract, see .
59-02783

ERMOSPHYSICAL PROPERTIES OF LINE WATER,
nsanto Research Corp. Everett, Mass.
For primary bibliographic entry see Field 01B.
For abstract, see .
W69-02784

VAPOR PRESSURE LOWERING OF AQUEOUS SOLUTIONS AT ELEVATED TEMPERATURES,
Westinghouse Research Labs., Pittsburgh, Pa.
For primary bibliographic entry see Field 01B.
For abstract, see .
W69-02785

3B. Water Yield Improvement

WATER HARVESTING PLAN FOR LIVESTOCK OR HOME,
Arizona Univ., Tucson. Coll. of Agriculture.
C. Brent Cluff.
Progressive Agriculture, College of Agriculture, University of Arizona, Vol. XIX, No. 3, pp 6-8.
OWRR Project A-001-Ariz.

Descriptors: Watershed management, Water yield, Water storage.

Treated catchments have been used since Biblical times for obtaining water supplies. The chief limitation on this technique has been the high cost per unit of water produced. With advances in modern technology, costs of treatment have been greatly reduced. Use of chemically inert plastic holds considerable promise both in treatment of catchment areas and sealing of storage tanks. An one half-acre gravel-covered plastic catchment was established using a newly developed plastic-laying gravel spreader. Runoff from the catchment flows into an 100,000 gal. storage tank lined with plastic and covered with butyl rubber. The installation and materials costs of both catchment and tank is estimated at 2,300. It is ecpected that the system will last at least 15 years, and provide a firm supply of 100,000 gal. of high quality water per year in an 11-inch rainfall zone. (Resnick-Ariz)
W69-02483

EFFECTS OF CULTURAL CHANGES ON MAKARA EXPERIMENTAL BASIN,
Ministry of Works, Wellington (New Zealand). Water and Soil Div.
C. Toebes, F. Scarf, and M. E. Yates.
Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 95-122, Sept 1968. 28 p, 17 fig, 3 tab, 17 ref.

Descriptors: *Small watersheds, *Agricultural watersheds, *Cultural control, *Overland flow, *Infiltration, Soil management, Hydrographs, Peak discharge, Duration curves, Grazing.
Identifiers: *Hydrological processes, New Zealand, Oversowing, Topdressing.

The effects of oversowing and topdressing unimproved pastures on small catchments of a few acres each is discussed. Analyses are intended to determine hydrological tendencies and are of a preliminary nature only. The land management change indicated has, together with a trebling of the production, had a considerable hydrological effect. There has been some decrease in annual run-off, a probably increase in infiltration, an increase in surface detention, a reduction in the number of days on which flow occurred and a reasonably uniform decrease in the percentage occurrence of given daily run-offs over the greater part of the flow range. Individual hydrographs have shown no decrease in rise time, but an increase in depletion time, decreased peak discharges and decreased run-off.
W69-02502

MANIPULATION OF WATER USE IN AN ASPEN FOREST,
Utah State Univ., Logan; and Utah Center for Water Resources Research, Logan.
John D. Schultz, George B. Coltharp, George E. Hart, and Michael Zan.
Proceedings of the Third Annual American Water Resources Conference, 1967, pp 149-159. 11 p, 3 fig, 1 tab, 13 ref.

Descriptors: *Water utilization, Evapotranspiration, *Water supply, Vegetation, Hydrologic budget, Utah, Soil moisture.
Identifiers: Aspen, *Vegetation manipulation.

Our society is continually searching for new sources of water to exploit. Manipulating wild land vegetation to augment water supplies is a field of consideration which embodies two considerations--tapping new water supplies and making more efficient use of existing supplies. It is often stated that some types of wild vegetation use more water than is actually required to keep them alive. Whether or not such claims are correct, it is true that some forest trees grow on sites and in climates where their water supply is not as great as it is in other places. Thus, the idea of manipulating wild land vegetation to decrease water use has been popular for some time. A growing body evidence indicates that definite increments to water supplies may be obtained when watershed vegetation receives certain treatments. The authors' data for the growing seasons of 1966 and 1967 indicate that significant changes in the water use budget in an aspen forest can be accomplished by vegetative manipulation. The possibilities of success are greater in areas where greater amounts of precipitation are encountered, but it is apparent that these are tools of watershed management in water-scarce areas where even a slight increase in water yield is important. (Seneca-Rutgers)
W69-02541

IATT LAKE WATER CONSERVATION DISTRICT.

LA Const Art 15, Para 4 (1956).

Descriptors: *Louisiana, Legislation, *Water district, *Conservation, Fresh water, *Water supply, Lakes, Streams, Pollution, Ditches, Channels, Dams, Levees, Administrative agencies, Eminent domain, Local governments.
Identifiers: Iatt Lake.

This section creates the Iatt Lake Water Conservation District. The purposes of the District are: (1) to make available an adequate fresh water supply for industrial and other consumption; (2) to preserve the waters of the District; (3) to prevent pollution and blocking of streams; (4) to prevent contamination; (5) to acquire and operate facilities in the District; (6) to prevent the escape of any such waters until employed to the maximum benefit. The Board of Commissioners of the District is granted powers necessary to accomplish the District's purposes. Among the powers specifically enumerated in this section is the power to incur non-funded debt. (Childs-Fla)
W69-02731

3F. Conservation in Agriculture

ADVANCED PIPELINE TECHNOLOGY FOR IRRIGATION PROJECTS,
United Technology Center, Sunnyvale, Calif.
For primary bibliographic entry see Field 08A.
For abstract, see .
W69-02559

MANAGEMENT: A KEY TO IRRIGATION EFFICIENCY,
Leonard J. Erie.
Proc Amer Soc Civ Eng, J Irrig Drain Div, Vol 94, No IR3, pp 285-293, Sept 1968. 9 p, 2 fig, 4 tab, 10 ref, append.

Descriptors: *Irrigation efficiency, *Efficiencies, *Irrigation, *Water management (Applied), Water conservation, Crops, Sugar beets, Irrigation systems, Sprinkler irrigation, Consumptive use, Fruit crops, Sorghum, Water utilization.
Identifiers: Grapes.

Irrigated agriculture accounts for 80-90% of all water consumptively used in the United States. Nearly 42% of the water delivered to irrigated

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farms is not used beneficially by plants. Part of this water is waste that could be avoided by proper management. Inefficient water application can be minimized if the questions of when, how, how much, and why water is applied are answered. Many western states have results of studies indicating the optimum times to irrigate. When such information is not available, consumptive use estimates, coupled with knowledge of soils and root systems, provide a good basis for scheduling irrigations. Recent trends in most efficient irrigation systems are toward sprinkler, dead-level, and pump-back irrigation systems. Periodic releveling of soil on existing systems improves the efficiency and distribution of irrigation water. Labor problems, water shortages, and increased costs of all farm operations have necessitated improving irrigation systems. All communities have different problems and their approach to water conservation will be equally different. However, education, research, and technical assistance to the individual irrigation farmer must be used to obtain the greatest benefit from our limited water resources. (USBR)
W69-02567

OPTIMUM IRRIGATED PRACTICE UNDER CONDITIONS OF DEFICIENT WATER SUPPLY,
California Univ., Los Angeles.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02610

EFFECT OF ANTITRANSPIRANT TREATMENT ON LEAF TEMPERATURES,
Hebrew Univ., Jerusalem (Israel). Dept. of Botany.
J. Gale, and A. Poljakoff-Mayber.
Plant Cell Physiol, Vol 6, No 1, pp 111-115, March 1965. 5 p, 2 fig.

Descriptors: *Transpiration control, *Air temperature, Wind velocity, *Leaves, Transpiration, Thermal stress, Heat balance, Emulsions, *Inhibitors, Temperature, Cooling, Fluctuation.
Identifiers: *Leaf temperature, Thermistor probe, Thermocouple.

Three different antitranspirants, all of the plastic emulsion type, were tested. Leaf temperatures were determined in the field by a thermistor probe and in the laboratory by a rapidly equilibrating thermocouple contact probe. The antitranspirants were: Tag-a polyethylene based emulsion, a copolymer dispersion of acetate acrylate esters and a copolyacrylic emulsion. All three antitranspirants were found to be not toxic to any of the plants in the experiments. Despite wide fluctuations of air temperature and moderate wind conditions in the field, leaf temperatures were at all times plus or minus 2 degrees C of the ambient air temperature. There was no consistent difference between the leaf temperatures of control and antitranspirant-treated plants. Use of copolymer dispersion of acetate acrylate esters on bean plants caused transpiration to be reduced by 36%. Under field conditions, transpiration was only a minor factor in cooling plant leaves. It is most unlikely that antitranspirants could raise plant leaf temperatures to thermal death point in arid climates. (Blecker-Arizona)
W69-02767

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on THE Surface

DRAINAGE BY COUNTIES.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02412

LABBADIN V BAILEY (WATER LEVEL).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02428

NEKOOSA-EDWARDS PAPER CO V PUBLIC SERVICE COMM'N (PERMITS FOR DIVERSION OF NAVIGABLE WATERS).

8 Wis 2d 582, 99 NW 2d 821-828 (1959).

Descriptors: Flow, Streamflow, *Alteration of flow, Navigable waters, *Administrative agencies, *Wisconsin, Legislation, Diversion, Water management (Applied), *Water permits, Permits, Riparian rights, Administrative decisions, Agriculture, Irrigation, Judicial decisions.

Riparian owners petitioned the court to set aside an order of the commission granting permits for the diversion of nonsurplus water from a navigable stream. Wisconsin statutes, sec 31.14, provides for the commission to issue permits for the diversion of surplus water from navigable streams for the purpose of maintaining the normal level of any navigable lake or the normal flow of water of any navigable stream. Permits for the diversion of nonsurplus water shall be issued only with the consent of riparian owners damaged thereby and for the purpose of agriculture or irrigation. In this case petitioners did not consent to nonsurplus water being diverted for this purpose, but the commission issued permits upon a finding that these riparian owners would not be damaged thereby. The Wisconsin Supreme Court held that this statute did not confer authority upon the commission to make such a finding. Once the commission determined this to be nonsurplus water it was powerless to issue the permits without the consent of the petitioners. Jurisdiction still rests with the courts to determine common-law rights of riparian owners with regard to nonsurplus waters in navigable streams. (McDermott-Fla)
W69-02430

HENRY V BAHNS (DRAINS).
165 NE 2d 686 (Ohio Ct App 1959).

Descriptors: Water law, Subsurface drains, *Closed conduits, Stress, Water pressure, Flow resistance, *Ohio, Judicial decisions.

Plaintiff farmers sought to prevent county from tiling and straightening a drainage ditch inasmuch as the engineering plans for the work did not provide for sufficiently large tiles to carry the expected volume of water. The basic issue involved was the adequacy of the size of the tile proposed to be used by the county in constructing the improvements. The size of the proposed tiles had been reached by applying a mistaken theory since tiles of the same size had previously failed in the same ditch for unknown reasons. The decision of the trial court, upholding the plan adopted by the county commissioners, was reversed and the case remanded for further proceedings according to law. (Dann-Fla)
W69-02431

KREBS V VIGOR (LATERAL DRAINAGE).
164 NE 2d 811-812 (1958).

Descriptors: *Surface drainage, Laterals, Waste water, Water law, Surface runoff, *Ohio, Judicial decisions.

Plaintiff sought to temporarily restrain the board of education from constructing lateral ditches which would drain waste water into an existing drainage ditch which crossed plaintiff's land. Plaintiff alleged that the existing ditch was too small for its present flow and was overburdened by the flow from several presently existing lateral ditches. In denying the relief sought, the court noted that the plaintiff might well have a cause sufficient to merit permanent relief, but felt that plaintiff had not sufficiently proved his case, especially in light of the fact that to grant the relief sought would hamstring the construction of a new school. (Dann-Fla)
W69-02432

MALLARD V PYE (DRAINAGE).
215 Ga 645, 112 S E 2d 620-621 (1960).

Descriptors: Surface drainage, Surface runoff, Flow around objects, *Natural flow, *Obstruction to flow, *Surface waters, Watercourses, Natural flow, Doctrine, Overland flow, Water rights, *Judicial decisions, Ditches.

This is an action grounded in equitable estoppel brought by a higher owner against a lower owner to enjoin the lower owner from constructing and maintaining obstacles on her property which interfered with the natural flow and drainage of surface waters across petitioner's property. The court granted the injunction holding that a lower property owner owes a servitude to a higher owner so as to create a duty to receive normal surface flowage, provided the higher owner has done no act to increase such flow by artificial means. (Carruthers-Fla)
W69-02433

MACKEY V LUBIN (ARTIFICIAL BARRIERS).
9 Chest 193-200 (Pa Com Pl 1959).

Descriptors: Judicial decisions, Legal aspects, Artificial watercourses, Barriers, Flooding, *Reasonable use, *Negligent inundation, Diversion structures, *Pennsylvania, Surface waters, Surface drainage, Natural flow, Obstruction to flow, *Surface runoff.
Identifiers: Artificial barriers.

In the process of developing his land for residential purposes, defendant opened a road and slightly graded an adjoining road bringing about a small increase in the soil content of the surface water which naturally drained onto plaintiffs' adjoining land. Defendant also caused dirt fill to be piled in such a way as to constitute a barrier to the natural flow of surface water. Normal hard rains caused a break in the barrier, and, because of its concentration, the water deviated from its natural channel over the plaintiffs' land, damaging a row of pine trees. The plaintiffs could not recover for the increase in soil content of the water draining into their land because an upper landowner may make proper and profitable use of his land even though such use may result in some change in quality or quantity of the water flowing to lower land. However, the plaintiffs recovered for the damage to their pine trees caused by the break in the barrier. An upper landowner may not negligently cause unnecessary damage to a servient owner nor erect an artificial barrier to collect and discharge surface waters in greatly increased quantities upon his neighbor's property. (Molica-Fla)
W69-02438

JACOBS V FRANGOS (DIVERSION OF SURFACE WATER).

329 SW 2d 262-264 (Ct App Mo 2959).

Descriptors: Watercourses (Legal), Legal aspects, Judicial decisions, *Alteration of flow, *Ditches, Trenches, *Missouri, Soil erosion, Water injury, Natural flow, *Flood damage, Streamflow, Floods, Obstruction to flow, Stream beds, Diversion.

Defendants excavated a ditch in a creek bed which changed the natural course of the stream. Plaintiffs, adjoining landowners, brought suit to recover for flood and erosion damage to their property which thereafter resulted during periods of high water in the creek. Defendants contended that the trial court erred in giving a jury instruction as to the change of the natural water course of the creek since no evidence was introduced on this issue. The court held that the basis of plaintiffs' claim was not that an entirely new watercourse had been created by the defendants, but that through their excavation they diverted the water from its natural course onto the land of the plaintiffs causing damage. One

ıy not obstruct or so divert the natural flow of a eam without liability for ensuing damage to ners. (Molica-Fla)
69-02439

ELKE V COUNTY OF FARIBAULT INDINGS NECESSARY TO OVERTURN RAINAGE ORDER).
0 NW 2d 145-150 (Minn 1961).

scriptors: *Minnesota, Judicial decisions, Drainage programs, Drainage, Ditches, Drainage ter, Public health, Local governments, *Estiıted benefits, Estimated costs, Assessments.
ntifiers: Police power.

is was an appeal from a board of county commisner's order which established a ditch to improve existing drainage system. To overthrow such an der, under Minnesota statute, it must be shown t the total estimated cost of the project, includ- damages, is greater than the estimated benefits that the order appealed from is unlawful and unsonable. The court held that neither of these teria were met by the appellant. The court ther held that even if there was evidence that assments as to particular tracts of land were ereous, this was not sufficient to vitiate the entire der. (Sisserson-Fla)
69-02440

ORRIS V CUMMINGS (INCREASED SURCE WATER FLOW DAMAGING LOWER TATE).

6 SE 2d 592-594 (Ga 1960).

scriptors: *Surface water, Drainage ditch, Water w, *Water control, *Drainage systems, Rain ter, *Surface runoff, Standing waters, *Drainage ects, *Controlled drainage, Natural flow, Regued flow, Culverts, Judicial decisions.
ntifiers: Debris.

titioner claimed that defendants had created a isance by artificially increasing the natural flow surface water from their property onto that of petitioner and requested that the defendants be joined from continued operation of this alleged isance. Defendants had dug a drainage ditch ross their property to carry off the surface water. e ditch emptied into the street causing damage the street and to the plaintiff's property on the ner side. There had once been an agricultural ch across the property, but it had been in a difent place and had been filled in many years be- e. The court said that, 'as to surface water, one d proprietor has no right to concentrate and colt it, and thus cause it to be discharged upon the d of a lower proprietor in great quantities at a rticular locality, or in a manner different from t in which the water would be received by the ver estate if it simply ran down upon it from the per by the law of gravitation.' The injunction was anted. (Rief-Fla)
69-02455

OOD V SLEFKIN (SUIT TO ENJOIN DAM WNER FROM CHANGING WATER LEVEL).

3 A 2d 683-689 (RI 1958).

scriptors: *Rhode Island, Judicial decisions, Riparian rights, *Dams, Reservoirs, Streamflow, atural flow, Alteration of flow, Lakes, *Water vels, Water level fluctuations, Bodies of water, poundments, Impounded waters, Sewage sludge, version.
ntifiers: Artificial lakes.

it was brought by several landowners whose land utted a pond created by the respondents' dam. ndowners on the stream below the dam also ought suit. The owners on the pond complained at the dam owners had permanently lowered the el of the pond, exposing sludge deposited by a sewage disposal plant. The owners below the dam complained that the flow of the stream had been substantially increased. On appeal the Rhode Island Supreme Court held that even though respondent dam owners had gained a prescriptive right to overflow the lands of complaints above the dam, there was no reciprocal right in the landowners to have the pond maintained at the same level. This holding applied also to the owners below the dam, who sought to compel the respondent to continue to maintain the dam in the same manner. The owners of land abutting the pond contended that exposure of the sludge created a nuisance because of the foul odor emitted. The court said that an essential element of a nuisance is that the person to be charged with liability must have an element of control over the condition. In this case, the muck was deposited by a sewage disposal plant which was beyond control of respondent. The court said that riparian owners below a dam have a right to the natural flow of the stream without diversion, but in this case the landowners below the dam had not overcome the burden of proof that they were riparian owners. (Williams-Fla)
W69-02465

SEEPAGE UNDER SHEET PILES,
Birmingham Univ. (England).
R. Herbert.
Civ Eng, Vol 63, No 746, pp 977-980, Sept 1968. 3 p, 5 fig, 3 tab, 5 ref.

Descriptors: *Seepage, *Sheet piling, *Electric analogs, *Groundwater flow, Electrical networks, Flow nets, Ground water, Head losses, Darcys Law, Discharges, Aquifers, Resistors, Hydraulic gradients, Foreign research, Simulation.
Identifiers: Great Britain, Accuracy.

An accurate new method is described for representing seepage under sheet piles by adapting the normal resistor network technique for seepage systems to simulate singularities. Singularities occur in seepage systems when any flowline turns through a sharp angle such as at the base of sheet piles. Large head losses occur at these points, and if they are ignored when obtaining a solution to a sheet pile system, gross errors in discharge estimates can occur. Accuracy (discharge to 1%) of the technique, when simulating flow under sheet piles, is demonstrated by the analytical solution of 3 simplified sheet pile systems. Complex seepage problems, including multilayered aquifers with more than one sheet pile penetrating to varying depths, can be simulated. The technique uses a resistor network to solve the finite difference form of the ground-water flow equation, but is easily adaptable to all finite difference-based solutions and, in particular, is suitable for use in the well-established relaxation technique for seepage solution. (USBR)
W69-02574

AIRPHOTO INTERPRETATION AS AN AID IN FLOOD SUSCEPTIBILITY DETERMINATION,
Department of Energy, Mines and Resources, (Canada).
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02597

ANALYTICAL SIMULATION,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02605

LINEAR DYNAMIC DECOMPOSITION PROGRAMMING OF OPTIMAL LONG RANGE OPERATION OF A MULTIPLE MULTI-PURPOSE RESERVOIR SYSTEM,
California Univ., Berkeley.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-02617

PROJECT YIELDS BY A PROBABILITY METHOD,
Colorado River Board of California, Los Angeles.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02623

CHAPTER 5: NATURAL WATERCOURSES,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02626

CHAPTERS 6-10: PERCOLATING GROUNDWATER; SUBTERRANEAN WATERCOURSES; SPRINGS; SURFACE WATER; DRAINAGE,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02627

HAFERKAMP V CITY OF ROCK HILL (ACTION FOR DAMAGES FROM COLLECTION AND DISCHARGE OF SURFACE WATERS).

316 S W 2d 620-630 (M 1958).

Descriptors: *Missouri, Judicial decisions, Damages, Cities, Drainage, Pipes, Surface runoff, Surface waters, Channels, Ditches, *Storm drains, Discharge (Water), *Repulsion (Legal aspects), Sinks, Natural flow doctrine, *Alteration of flow, Roads, Watersheds (Basins), Water law.

Property owners brought this action for damages caused by the alleged unlawful collection and discharge of surface waters upon the plaintiffs' property by the developers of a subdivision. The plaintiffs won in the trial court, but the Supreme Court of Missouri reversed and remanded. The Supreme Court held that where the subdivision developers had artificially collected waters into a concrete pipe which ended at a natural drainage channel leading to a sinkhole on the plaintiffs property, there was no violation of the property owners' rights because the surface waters would naturally flow to the sinkhole regardless of how they were collected. Missouri, with modifications, adheres to the 'common enemy doctrine'. Stated in its extreme form, each landowner has the unqualified right to fend off surface waters as he sees fit without being required to take into account the consequences to other landowners, who have the duty and right to protect themselves as best they can. This right to fend off surface waters is preserved even though in doing so one might increase and accelerate the flow of surface waters, causing damage to other land. (Watson-Fla)
W69-02636

PRICE V DICKSON (HOMEOWNERS ACTION AGAINST SUBDIVISION DEVELOPERS FOR DAMAGES FROM FLOODING OF BASEMENT).
317 S W 2d 156-158 (Ky Ct App 1958).

Descriptors: *Kentucky, Judicial decisions, *Damages, *Flooding, Surface runoff, Drainage, Ditches, Storm runoff, Subsurface runoff, *Storm drains, Sewers, Manholes.
Identifiers: Negligence.

Homeowners brought an action against subdivision developers for damages to their residence resulting from a flooding of their basement. The homeowners won in trial court. The Court of Appeals of Kentucky affirmed the decision, holding that the acts of the subdivision developers in filling up a ditch into which storm sewers constructed under the homeowners' lot naturally drained created, or substantially contributed to, the flooding condition. The subdivision developers were negligent in failing to provide adequate drainage from the ditch they had altered for their purposes.

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The trial judge's instructions to the jury authorized them to award the plaintiffs such sums as will reasonably compensate them for diminution in the value and use of the property. The court stated that the cost of reasonably necessary repairs, as well as the discomfort caused by the injury, are factors to be considered under this standard instruction when the injury is one of a temporary nature. (Watson-Fla)
W69-02638

THORSON V BOARD OF SUPERVISORS OF HUMBOLDT COUNTY (SUBSTANTIAL COMPLIANCE WITH DRAINAGE PLAN).

90 N W 2d 730-737 (Iowa 1958).

Descriptors: *Iowa, *Drainage districts, Judicial decisions, Local governments, *Bank erosion, Canal embankments, Channel erosion, Slopes, Banks, Channels, Drainage, *Drainage engineering, Ditches, Drainage programs, Drains, Tile drains, Excavation, Canal construction, Legislation.

Plaintiff, a landowner, objected to the county engineer's certificate that work upon a drainage improvement district had been completed in accordance with plans and specifications. His basic objection was that the excavation of the drainage channel, particularly on its south bank, is rough and uneven; and that it does not conform to the slope required but is vertical, resulting in caving in of earth to obstruct the flow of water in the ditch and to undermine the roadway of the adjoining public highway. An expert testified that in his opinion further excavation would only increase slipping of the banks and likelihood of damage to the highway because of the unusual character of layers of clay soil found there; and that the work as done furnished adequate drainage for the district, including an outlet for plaintiff's tile. The court held that defendant's failure to direct the engineer to make a report showing changes or modifications of the plan necessary to meet changed conditions did not prevent it from accepting the work, because statutes concerning drainage districts should be liberally construed. An informal consultation between the defendants and the engineers was held to be sufficient compliance with the statute requiring a report showing such changes or modifications of the plan as might be necessary to meet the change of conditions. (Scott-Fla)
W69-02639

FLOOD CONTROL AND RELATED MATTERS.
La Rev Stat secs 38:81-83 (1965).

Descriptors: *Louisiana, United States, Legislation, *Flood control, Administrative agencies, Navigation, Rivers, Land reclamation, Reforestation, Land development, *State governments, Water resources development.
Identifiers: Federal Flood Control Act.

The governor is authorized to enter into contracts with federal authorities with respect to the control of flood waters, navigation of rivers flowing through the state, land reclamation, and related matters. The governor is authorized to accept lands from the United States as provided by the flood control act. The governor may perform any act necessary to obtain relief provided for by the flood control act. (Childs-Fla)
W69-02645

BRISTOL COUNTY WATER CO V OLIVIERA (EMINENT DOMAIN FOR PROTECTION OF A RESERVOIR).

141 A 2d 443-447 (R I 1958).

Descriptors: *Rhode Island, *Eminent domain, Judicial decisions, *Reservoirs, Water storage, Saline water, Water pollution, Water supply, Dams, *Dikes, Administrative agencies, Condemnation.

Bristol County Water Company initiated proceedings to condemn land in order to erect a dike to prevent the inundation of its reservoir by sea water. The owners of such land objected to it being condemned, and excepted from the lower court's finding that the taking was necessary. The exceptions were based primarily on the landowner's contention that the company's condemnation was improper. The court held that it was proper, and that the proposed dike was not a 'dam,' the specifications of which were required to be submitted to an administrative officer. It also held that where the company had already built a reservoir, a dike to prevent its inundation by salt water did not substantially alter its character, which would have required the submission of specifications to the Chief of the Division of Harbors and Rivers. Finally, the court held that the record showed the trial judge was not clearly wrong in his determination of the public necessity of the taking. The case was remitted to the trial court for further proceedings. (Williams-Fla)
W69-02650

MCHUGO V KOZAK (INTERFERENCE WITH NATURAL FLOW OF A STREAM).
188 NYS 2d 253-256 (N Y Sup Ct 1958).

Descriptors: *New York, Judicial decisions, Legislation, *Obstruction to flow, *Diversion, Stream flow, Natural flow, Damages, Erosion, Flood damage, Dams, *Natural streams.

Upper landowners sought an injunction pendente lite to restrain lower landowners from interfering with the alleged natural channel of a stream. Allegedly an obstruction placed across the stream caused the stream to follow a new channel, dug by defendants, to an abandoned mill race. This interference with the natural flow of the stream caused the water to back up, doing damage to plaintiff's lands. Defendants interference with the natural flow by diverting a portion of the flow over a different portion of their own land. The court found the evidence insufficient to show any damage. A temporary injunction will only be granted where irreparable injury is threatened and where the right is established with undisputed clearness. The granting of the injunction is also discretionary. (Childs-Fla)
W69-02654

MILLS, DAMS AND RESERVOIRS.
Mass Ann Laws ch 253 secs 1-62 (1967).

Descriptors: *Massachusetts, Legislation, *Reservoirs, *Mills, *Mill dams, Water law, Legal aspects, Impounded waters, Water damage, *Operation and maintenance, Dam construction, Dam design.

A person may, subject to this chapter, erect a mill and dam in any non-navigable stream in order to raise water for work purposes. A dam may not be erected to the injury of a lawfully existing mill. Provision is made for recovery of damages by persons whose land is injured by the overflow caused by dams. An enforceable lien is placed on the mill, dam, and land of the violator as of the date a petition is filed against him. The statute states that the inclusion of this remedy is to preclude the use of common law remedies for the recovery of damages caused by dam construction and maintenance. Other provisions cover collection and payment of damages and filing of new petitions. Secs 39-41 concern dams to flood land for cultivation of cranberries and to form ice ponds. Secs 42 and 43 concern dams of reservoir corporations. Safety and inspection procedures for the construction and maintenance of dams and reservoirs are set out in Secs 44 through 50. Secs 51 through 62 concern required repairs and rebuilding of mills and mill dams. (Williams-Fla)
W69-02657

WERLING V NEW HAVEN CONSERVATION CLUB (INJUNCTION TO REMOVE DAM).
154 N E 2d 124-125 (Ind Ct App 1958).

Descriptors: *Indiana, Judicial decisions, Conservation, *Dams, Flow, Channels, Natural flow doctrine, *Flooding, Rainfall, Drainage, *Tile drains, Silts, Rivers, Obstruction to flow, Surface drainage, Surface runoff.
Identifiers: Injunction, Gulleys.

Plaintiff sought a mandatory injunction to compel defendant to remove a dam and to refrain from interfering with the flow of water along a natural watercourse. The trial court denied the injunction, and the Appelate Court of Indiana affirmed. The appelate court held that the evidence justified the finding that defendant's dam had nothing to do with flooding the plaintiff's lands. The plaintiff's land drained through a line of tile into a gulley. The defendant built a dam across the gulley. The evidence indicated that the overflow of plaintiff's land was due to the fact that the line of tile was broken down in places and filled with silt and debris. The flooded condition of the plaintiff's land was due to the failure of such defective tile to carry over normal rainfall and not to the back-up of water in the tile caused by plaintiff's dam. (Watson-Fla)
W69-02715

NAVIGATION AND SHIPPING; CANALS AND OTHER WATER COURSES.

La R S 34:341-346; 34:361 (1965).

Descriptors: *Louisiana, Local governments, Public benefits, Right-of-way, State governments, *Locks, *Canals, *Navigation, Inland waterways, Levees, Mississippi River, Ownership of beds, Legislation, Eminent domain, Condemnation.

The Commissioner of Wild Life and Fisheries is authorized to acquire any systems of locks and canals in the coastal parishes of the State which are useful to vessels engaged in the sea food industries of the state. He is also authorized to operate said canals and locks. Canals and locks may be acquired by purchase, lease, or eminent domain proceedings. The purpose of the law is to provide free navigation and lockage in the systems so as to foster and develop the sea food industry of the State. When these facilities form a part of a levee system, including the navigation locks and facilities in the Mississippi River, they shall be maintained and operated by the Department of Public Works. Owners or person in charge of locks may not charge more than a maximum statutory fee for any vessel owned by the State. Any domestic corporation established for the purpose of cutting canals in the state shall have a right of way through any state owned land for the canal and the use of the banks thereof for depositing the excavated dirt. (Scott-Fla)
W69-02724

PROPERTY OWNERS.
La R S 33:5060-61 (1965).

Descriptors: *Louisiana, *Local governments, Drains, Sewers, Conduits, Culverts, Inspection, Cities, Construction, Dam construction, Legislation.

All owners of real property must receive the approval of the municipal authorities before constructing any artificial drain, storm sewer, conduit or culvert across private property. The municipal government may inspect all work to see that it complies with the specifications and plans it previously approved. All municipalities may adopt ordinances necessary to carry out the above and may provide penalties for any violations. (Scott-Fla)
W69-02725

CITY OF LAKE CHARLES RECLAMATION AND DEVELOPMENT OF LAKE BED AND WATERFRONT.
La Const Art 14, sec 47 (1966).

escriptors: *Louisiana, Legislation, Local governents, Cities, *Land reclamation, *Lake beds, Emnkments, Breakwaters, Sea walls, Jetties, aches, *Financing.
entifiers: *Mineral rights.

is section grants to the city of Lake Charles the wer to construct and maintain embankments, awalls, jetties, breakwaters, waterbasins and ner works as well as public parks, plazas, aches, and related developments. All mineral hts are reserved to the state. The City of Lake arles is also empowered to issue additional nds to finance these projects. (Childs-Fla)
69-02732

BINE RIVER AUTHORITY.

Const Art 14, sec 45 (1960).

escriptors: *Louisiana, Legislation, *Administrae agencies, *Navigation, Drainage, *Flood conl, Irrigation, Water supply, Hydroelectric power, ited States, Texas, Dams, Locks, Canals, droelectric plants, Watershed management.
entifiers: Sabine River, Calcasien River.

e Sabine River Authority is an agency of the te. The purposes of the Authority are: (1) to imve navigation on the Sabine River; (2) to proe adequate drainage and flood control within e Sabine River and Calcasien River watersheds;) to utilize the Sabine River for recreation and vigation; (4) to maintain an adequate water pply; and (5) to develop hydroelectric power. e governing body of the Authority is given broad wers of control and management to accomplish e Authority's purposes. (Childs-Fla)
69-02734

RIVE-IN REALTY CORP V LEWIS ISCHARGE OF SURFACE WATER).

2 NYS 2d 671-675 (NY Sup Ct 1961).

escriptors: *Judicial decisions, *New York, epulsion (Legal aspects), *Surface runoff, Surce drainage, Rainwater, Ditches, Water law, ater rights.

aintiff, operator of a drive-in theater on one side a road, brought suit against defendant, who ned a shopping center on the opposite side. aintiff asked for money damages as a result of oding which it alleged was due to a nuisance on fendants' property. Defendants' land was higher an plaintiff's. Plaintiff alleged that due to grading, nstruction of a building and parking lot, and an dequate drainage system, large quantities of ter overflowed into a natural gulley and were scharged across the street onto plaintiff's proper. The court, following the common enemy rule, ld for defendant. Defendant's improvements re made in good faith, and liability would not atch even though the grading and paving directed e flow of surface water toward plaintiff's property d accellerated such flow. Even if the drainage stem was inadequate, the natural flow was vertheless onto plaintiff's property, and defennt did not discharge any water by artificial pipes ditches. (Williams-Fla)
69-02741

4B. Groundwater Management

RANTZ V COLLINS (RIGHT TO USE A ELL).
Ill 2d 446, 173 NE 2d 437-440 (1961).

escriptors: *Water supply, *Water rights, *Easeents, Wells, Real property, Legal aspects, Pipes, onduits, Judicial decisions, *Domestic water.
entifiers: Implied easements.

aintiffs brought action to enjoin defendants from terfering with plaintiffs' right to pipe water to his residence from a well located on the defendants' property. The property belonging to each party originally constituted a single tract owned by a building contractor. The contractor dug the well in the middle of the tract and subsequently sold one half of the tract to plaintiffs and defendants respectively, intending the well to serve each parcel. A later survey determined that the well was entirely on the defendants' property. The court noted that it is generally held that where the owner of a single tract has arranged or adapted it so that one portion derives a benefit from the other of an apparent and continuous character and then sells one of such parts without mention being made of these incidental uses, the grantee takes his property with all the rights and obligations which formerly existed. Here, at the date of the defendants' conveyance, an easement for the taking and transmitting of water from the well was impliedly reserved by the contractor for the remaining parcel. (Horner-Fla)
W69-02444

CRANE V BOROUGH OF ESSEX FELLS (POWER OF A MUNICIPALITY TO ACQUIRE WATER RIGHTS BEYOND ITS TERRITORIAL LIMITS).

67 Super 83, 169 A 2d 845-852 (1961).

Descriptors: *New Jersey, Judicial decisions, *Wells, Subsurface investigations, *Cities, Condemnation, Eminent domain, Water demand, Water allocation (Policy), Water resources, *Competing uses, Relative rights, Legislation, Percolating water.
Identifiers: Injunctions.

Action by landowners to enjoin the defendant borough from conducting a 72-hour pumping test of a well that the borough had drilled outside its territorial limits. The landowners alleged that the test rendered their private wells useless, and contended that permanent use of the new well would effectively deprive them of a water supply. The Superior Court ruled in favor of the borough in denying the request for a permanent injunction. The court added that the borough must comply with requisite administrative requirements before unilaterally acquiring additional diversion rights. If the borough complied by seeking administrative approval, the court would not enjoin reasonable tests by the borough, seeking additional water sources. It was held that there was nothing to prevent a borough from seeking new water sources even if some of the new water was to be sold to nearby municipalities, and not used solely by the applying borough. The borough would, however, be bound by the doctrine of reasonable use and could not withdraw underground waters if withdrawal impaired reasonable uses of subsurface water by neighboring landowners. (Blunt-Fla)
W69-02456

SOUTH RIVER TIDAL DAM PROJECT, SPECIAL REPORT 21.
New Jersey State Dept. of Conservation and Economic Development.

N J Dep of Conserv and Econ Dev, Div of Water Policy and Supply, Spec Rep 21, Part 1, Intro and obj, 52 p; Part 2, Engr Rep, 61 p, 1965. 12 fig, 39 plate, 5 tab, 10 ref.

Descriptors: *Artificial recharge, *Aquifers, *Sands, *New Jersey, Dams, Reservoirs, Saline water intrusion, Cost analysis, Computer models, Digital computers, Water yield, Water quality, Reservoir silting, Sediment control.
Identifiers: *Recharge reservoirs, Bottom preparation.

A tidal dam is proposed for the South River, New Jersey, to prevent saline water from moving upstream and to impound fresh stream water in a permeable-bottomed reservoir to recharge the Old Bridge Sand aquifer. The aquifer is presently overpumped and saline water intrusion is becoming a problem. The recharge pond would provide about 30 mgd additional yield to the aquifer and would also have limited recreational use. Total pumpage in 1961 was over 30 mgd, about the natural recharge of the aquifer. The project would about double the safe yield and reduce the amount of saline water intrusion. Detailed plans for construction of the project are included. A digital computer model analysis of the extent and character of benefits was made in cooperation with the U.S. Geological Survey and the results are included. Total cost is estimated to be $4,700,000. (Knapp-USGS)
W69-02506

WATER-LEVEL TRENDS IN SOUTHEASTERN LOUISIANA,
Geological Survey, Baton Rouge, La. Water Resources Div.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-02513

GROUNDWATER MANAGEMENT UNDER QUADRATIC CRITERION FUNCTIONS,
Missouri Univ., Columbia. Dept. of Agricultural Economics.
Oscar R. Burt.
Water Resources Research, Vol 3, No 3, pp 673-682, Third Quarter 1967. 10 p, 8 ref.

Descriptors: *Groundwater, *Management, Recharge, Probability, Water supply, Costs, Equilibrium.
Identifiers: *Quadratic criterion function, Net output, Optimal decision rule, Diminishing returns.

Temporal allocation of groundwater is analyzed for quadratic measures of economic net output from a basin. The two variables of the net output function are rate of use and quantity of stocks. It is shown that an optimal policy for groundwater utilization over time is dependent upon the mean recharge rate but not on higher moments of its probability distribution for the case of quadratic criterion functions, provided that inequality constraints on rate of use are unnecessary. The optimal policy is derived, and some analysis of the probability distribution of groundwater stocks is made. Some consideration is given to approximating optimal policies for the situation arising when inequality constraints on rate of use are binding. (Seneca-Rutgers)
W69-02537

PLANNING FOR GROUND WATER BASIN MANAGEMENT,
California State Dept. of Water Resources, Sacramento.
Albert J. Dolcini.
Proceedings of the Third Annual American Water Resources Conference, 1967, pp 208-214, 7 p.

Descriptors: *Planning, Water resources development, *Water management (Applied), *California, State government, Waste disposal, Saline water intrusion, Water quality, Injection, Separation techniques, Benefits, Costs, Model studies.
Identifiers: Incentives, *California Department of Water Resources.

In the past much of the development of the ground water resources in California was not planned. At the present time the California Department of Water Resources is attempting to provide for the protection and planned management of the state's ground water resources. Plans for ground water basin management must not concern only quantity. Other problems which have become serious in California are the intrusion of sea water and saline connate water into ground water aquifers and pollution resulting from disposal of solid decomposable refuse in alluvial areas. Moreover, continued overdraft in certain interior ground water basins causes the problem of accretion of salts by reduction or elimination of subsurface outflow from the

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basin. Ground water basin management must be premised on the principle of total resource management--the full use of underground supplies and storage capacity, together with local and imported surface water to satisfy most effectively present and future water demands. Ground water basin management studies provide information useful to a local agency in the selection of an economical management plan. (Seneca-Rutgers)
W69-02544

SEEPAGE UNDER SHEET PILES,
Birmingham Univ. (England).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02574

EFFECT OF RIVER WATER QUALITY ON AN ADJACENT AQUIFER,
Cincinnati Univ., Ohio.
Herbert C. Preul, and L. V. Popat.
Systems Approach to Water Quality in the Great Lakes, Proc 3rd Annu Symp Water Resources Res, pp 73-96, Ohio State Univ, Sept 1967. 24 p, 11 fig, 5 tab, 8 ref.

Descriptors: *Water quality, *Mathematical models, Induced infiltration, Recharge, *Surface-groundwater relationships, Observation wells, Water levels, *Water wells, Water supply, Aquifers, Ion exchange, Pollutants, Pollutant identification, Adsorption, Water chemistry, Darcy's Law, Permeability, *River flow.
Identifiers: Great Miami River, S.W. Ohio Water Company, Network analysis.

Predictive mathematical models used to determine the quantity and quality of recharge from the Great Miami River to collector wells were presented. The quantity model, based on a simplified node-network model, representing ground basin dynamics based on Darcy's law, was a linear difference-differential model using one-half year as the increment of time. The concentration of pollutants was determined as the sum of concentrations introduced by the convective flux between the river and well. Calculated pollutant concentrations were tabled, and compared with measured concentrations. It was concluded that a high percentage of the water recharging the two collector wells originates from the river, and that the pollutant inhibitory capabilities of the aquifer, in the form of adsorption and ion exchange, were nearly exhausted. (Gysi-Cornell)
W69-02611

REVITALIZING A FERTILE PLAIN,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02620

CHAPTERS 6-10: PERCOLATING GROUNDWATER; SUBTERRANEAN WATERCOURSES; SPRINGS; SURFACE WATER; DRAINAGE,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02627

WATER WELL CONTRACTOR'S LICENSE ACT.

N C Gen Stat sec 87-65--87-70 (1964).

Descriptors: *North Carolina, *Legislation, Wells, *Administrative agencies, *Well permits, Well regulations, Permits, Pumps, Drilling equipment, Water resources, Public health, Water law.

The Board of Water Well Contract Examiners is created. No water well contractor may operate within the state of North Carolina unless he is licensed by the Board. The contractor must also obtain a permit from the board each year for every drilling rig he operates within the state. The Board is comprised of four water well contractors, along with one employee of the State Department of Water Resources, one employee of the State Board of Health, and one representative of the public. The board members serve three year terms. The section does not apply: (1) to an individual who drills a water well on land which is owned or leased by him and is used for farming purposes or as his residence; (2) to an individual who performs labor or services for a licensed water well contractor at his direction and under his personal supervision; and (3) to an individual who, by hand, digs, bores, washes, drives, jets, cores, repairs, or cleans wells without the use of power equipment. (Watson-Fla)
W69-02633

MACARTOR V GRAYLYN CREST III SWIM CLUB, INC. (ACCESS TO NEIGHBORING WATER SUPPLY).
173 A 2d 344-346 (1961).

Descriptors: *Ownership of beds, Preferences, *Water rights, Water law, Diversion, *Well regulation, *Delaware, Judicial decisions.

Plaintiff sought to enjoin defendant from pumping water from the well which was connected to the water source on plaintiff's property or to compel defendant to provide a permanent alternate source for plaintiffs. Defendants sunk a well approximately 170 feet deep on property adjacent to plaintiff's land to supply a swimming pool with a capacity of 200,000 gallons. After defendants began pumping from their well, plaintiff's six foot deep well went dry. The court noted that Delaware is without precedent in the case and that English common law prior to separation from the Crown would not fill this void. It then noted that there is a proliferation of American doctrines, all rejecting the present British doctrine of absolute ownership. Some American courts have merely modified the English rule requiring that the use be without waste and malice, citing Texas and Rhode Island. California has taken a position which would require proration of water among competing landowners without regard to reasonable use. Between these two extremes lies the rather amorophous 'reasonable use' doctrine which has been subdivided into several categories. The court seemed inclined to favor a position which would reflect a 'practical adjustment of conflicting interests,' but deferred ruling on the matter until the trial. (Dann-Fla)
W69-02659

CLOGGING AND CONTAMINATION PROCESSES IN RECHARGE WELLS,
Technion Israel Institute of Tech., Haifa; and Water Planning for Israel Ltd., Tel Aviv.
M. Rebhun, and J. Schwartz.
Water Resources Res Vol 4, No 6, pp 1207-1217, December 1968. 11 p, 5 fig, 7 tab, 8 ref.

Descriptors: *Artificial recharge, *Recharge wells, *Bacteria, *Organic matter, *Compatibility, Pumping, Performance, Efficiencies, Reliability, Laboratory tests, Water pollution.
Identifiers: *Israel, Coastal aquifer, Lake Kinnereth, Clogging, Well redevelopment, Bacterial mats.

Artificial recharge of production wells by water from a lake is practiced in Israel on a large scale. The observed clogging of recharge wells and contamination of water pumped in dual purpose wells are attributed to small concentrations of organic suspended matter in recharge water. Processes surveyed in the field and simulated in a laboratory column system lead to the conclusion that organics are filtered out near the recharging well, reducing hydraulic conductivity in fine textured aquifers. Bacterial contamination and organic material decomposition are inhibited until recharge termination, as growth control components are present in recharge water. A short time after recharge termination (about 2 days) conditions become favorable to organic material decomposition and bacterial growth. High coliform bacteria counts are observed for about 50 days. To avoid the difficulties encountered, it is suggested that recharge wells be redeveloped by small volume pumpage.
W69-02669

GEOLOGY AND GROUND-WATER RESOURCES OF THE DEER LODGE VALLEY MONTANA,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-02686

STATE V MARTIN (CONSTITUTIONALITY OF STATUTE REQUIRING WELL DRILLERS TO SUBMIT LOGS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02716

PREDICTING RETURN FLOWS FROM IRRIGATION,
Bureau of Reclamation, Denver, Colo.
Patrick A. Hurley.
Jour Irrig and Drain Div, ASCE, Vol 94, No IR 1, Proc Paper 5838, pp 41-48, March 1968. 8 p, 3 fig, 3 tab.

Descriptors: *Return flow, *Aquifer characteristics, *Analytical techniques, New Mexico, *Percolating water, Equations. Discharge measurement, Drainage, *Irrigation water, Transmissivity, Drainage, Reservoir storage, Monthly.
Identifiers: Mesilla Valley (New Mexico).

An analytical method for computing return flow or drainage from irrigation applications was presented and discussed. Computations considered aquifer properties, drain spacing, and deep percolation. A graph for determining the fractional part of percolation remaining in transient storage was included. Realistic estimates of irrigation return flow could be determined by using the graph and simple digital procedures. The method was used to determine monthly quantities for 13 years of return flows in the Mesilla Valley, New Mexico. (Affleck-Arizona)
W69-02762

4C. Effects on Water OF Man's Non-Water Activities

URBAN HYDROLOGIC RELATIONSHIPS,
Maine Univ., Orono.
For primary bibliographic entry see Field 02A.
For abstract, see .
W69-02408

MEIER V FRANK MASHUDA COMPANY (SURFACE DRAINAGE).

168 NE 2d 319-323 (Ohio 1959).

Descriptors: *Ohio, State governments, Surface water, Ditches, Drainage water, *Surface drainage, *Alteration of flow, Surface runoff, Water law, Paving, Roads, Excavation, Highways, *Road construction, Graded, Erosion control, Flood damage, Floods, Judicial decisions, Legal aspects.

Defendant had a contract with the state of Ohio to construct a portion of the new, or relocated, state road. In the course of that construction, certain grading, excavating, and laying of draintile was undertaken across from plaintiff's farm. Plaintiff alleged that the work done by defendant changed the flow of surface waters by diverting them to the western edge of the state road where, by reason of

e filling of the ditch by Mashuda, surface waters ere diverted to the eastern side of the road and ence over plaintiff's lands and into his barn. The urt held that the evidence presented at trial was conflict and that the jury could properly deter- ine that defendant's conduct constituted gligence proximately causing injury to plaintiff. ie court also held that the immunity from suit at- ching to a contractor carrying out an agreement th a public body does not extend to one who is ilty of negligence in the performance of such ntract. (Smith-Fla)
69-02442

RING VALLEY WATER WORKS AND PPLY CO V WILM (DIVERSION OF RIVER ATER).
8 NYS 2d 800-802 (1961).

escriptors: *New York, Judicial decisions, City anning, Indirect costs, Diversion, *Riparian ghts, Riparian land, Compensation, *Projects, blic benefits, Legal aspects, Local governments.
entifiers: Indemnity, Public necessity.

titioners sought to annual a determination by the ater Power and Control Commission which ap- oved a village's application for increased diver- on of river water. Petitioners, riparian land vners, alleged that the village had insufficient ovisions to make payment for legal damages to rsons and property which would result from the oposed water diversion. Petitioners further arged that the project was not justified by public cessity. The court unanimously rejected these ntentions upholding the commission's finding at there existed adequate financial resources in e village to indemnify petitioners and a sufficient otential public need to warrant the water diver- on project. (Sisserson-Fla)
69-02446

CHROEDER V CITY OF NEW YORK DEQUACY OF CONSTRUCTIVE NOTICE IN IVERSION PROCEEDING).

App Div 2d 183, 217 NYS 2d 975-977 (1961).

escriptors: *Judicial decisions, Diversion, Ripari- rights, *Alteration of flow, Cities, New York, djudication procedure, Administrative agencies, emedies, Riparian land, Legal aspects.
entifiers: Injunctions.

ne plaintiff, a riparian owner downstream from e defendant city, sought to enjoin defendant's version of stream waters. Defendant had served nstructive notice upon the downstream owners, various ways, for a period of six weeks prior to e diversion proceedings. The trial court granted e defendant's motion for judgment on the eadings and this court affirmed. The court held at the city's action in providing constructive otice was in compliance with the Administrative ode. The court held further that the constructive otice was reasonable calculated to provide the aintiff with actual notice of the city's intentions. uch notice was sufficient, in this type of action, to tisfy the notice requirements of both the New ork and Federal Constitutions. (Blunt-Fla)
69-02447

IANITTA V TOWN OF GEDDES (SURFACE RAINAGE BY DITCH).

App Div 2d 504, 217 NYS 2d 383-384 (1961).

escriptors: *Judicial decisions, Drainage systems, Ditches, Waste water disposal, *Riddance (Legal spects), Municipal wastes, *Waste water Drainage), Sewage disposal, *Water pollution ources, New York, Adjudication procedure.
dentifiers: Injunctions, Restraining orders.

he trial judge issued an injunction forbidding the efendant town to use a drainage ditch for the removal of excess water. Plaintiff had complained that such use by the town, coupled with the additional discharge of domestic sewage into the ditch, caused the channel to overflow onto the plaintiff's land. This court reversed and remanded the cause for further proceedings which should take into account the ability of the ditch to carry off this excess surface water after the completion of the pending sanitary sewage system. The court stated that the injunction was too broad in that it prevented any use of the ditch by the defendant. The town should be permitted to use the ditch if such use is within the extent of the natural capacities of the ditch. (Blunt-Fla)
W69-02448

COOK V STATE OF NEW YORK (FLOOD DAMAGE).

209 NYS 2d 588-591 (1961).

Descriptors: Floods, Flood control, *Flood damage, Flood routing, Flood protection, Flood plains, Floodways, *Streams, Levees, *Dikes, Embankments, Diversion structures, Natural flow, Judicial decisions, *New York.
Identifiers: *Castle creek.

As part of a highway improvement program, the state constructed an artificial embankment, which resulted in the diversion of creek waters from their natural course. An artificial dike was constructed at approximately the same height as the original embankment. Continuous heavy rainfall resulted in the washing-out of a portion of the artificial embankment. Plaintiff's lands were flooded, and he suffered property damages for which he seeks recovery from the State on the ground of negligence in the construction and maintenance of the dike. The court held that the evidence established that the damage sustained by plaintiff was the result of flooding caused by an Act of God and was not the result of negligence on the part of the state. (Carruthers-Fla)
W69-02449

YARDVILLE ESTATES INC V CITY OF TRENTON (INSTALLATION OF WATER MAINS).

168 A 2d 429-436 (1961).

Descriptors: *Public utilities, *Water supply, *New Jersey, Legislation, Cities, Utilities, Conduits, Water conveyance, Legal aspects, Contracts, Judicial decisions, *Water contracts, Water requirements.

Plaintiff development corporation brought suit to recover the cost of water mains installed by the plaintiff to connect its housing development with the water distribution system of defendant city. The plaintiff agreed to install the mains at its own expense as required by a city resolution. The court held that the city had statutory authority to contract for the construction of mains at the expense of those seeking water supply. The city may not impose discriminatory or illegal conditions upon users. Here, it did not; but even if it had, the plaintiff would be stopped from asserting that the defendant had abused its discretion because the plaintiff voluntarily entered into the contract. (Horner-Fla)
W69-02451

GILL V FIRST CHRISTIAN CHURCH, ATLANTA, GEORGIA, INC (CONSTRUCTION CAUSING INCREASED SURFACE RUNOFF AND DAMAGE).
117 SE 2d 164-166 (Ga 1960).

Descriptors: *Judicial decisions, Georgia, Natural flow, Doctrine, *Relative rights, Flood damage, Damages, *Surface water, Deposition (Sediments), Mud, *Running water, Soils, Judicial decisions, Legal aspects.
Identifiers: Trespass, Debris.

In a trespass action against the defendant church and its general contractor, plaintiff alleged that defendants caused water to accumulate in unnatural amounts upon the church property, which water flowed periodically down upon the plaintiff's land, carrying with it dirt, silt, and debris, and doing damage to the plaintiff's property. The trial court sustained the contractor's general demurrer to the plaintiff's petition. The contractor relied on the fact that it had completed construction and turned the building over to defendant church before plaintiff brought this action and, thus, could not be held liable along with the church. The plaintiff averred that she had called the conditions to the attention of the contractor several times without satisfaction during the course of the construction. This court reversed stating that one who commits a trespass upon the land of another is subject to be sued as a trespasser whether he is acting for himself or as an agent of another, and, if the agent commits the trespass while under the direction of a principal, both may be sued. Church had no right to concentrate the water on its land in greater than natural amounts and cause it to be discharged upon the plaintiff's land in a manner different from its natural flow. (Blunt-Fla)
W69-02454

ATTORAM REALTY CORP V TOWN AND COUNTRY BUILDERS (LIABILITY FOR SURFACE RUNOFF DAMAGE).

178 NYS 2d 105-109 (S Ct 1958).

Descriptors: *New York, Judicial decisions, *Drains, Pipes, *Surface runoff, Surface drainage, Drainage, Gullies, Erosion, *Land development, Water law, Diversion, Surface waters, Damages, Natural flow, Drainage systems, Ditches.

Plaintiff brought suit to enjoin defendant from diverting and discharging surface waters onto his land, and for damages. In connection with its development of adjacent land, defendant constructed a drainage system which discharged surface waters on plaintiff's land through three pipes. The supreme court found that plaintiff's land had not been damaged by the flow of surface water prior to the construction of the drainage system, and that it was materially damaged thereafter. The court held that defendant's action was the proximate cause of plaintiff's injury, and that the defendant should have reasonably foreseen such damage. One may improve his land through natural and normal alterations, and cause surface waters to be cast on the lands of another without liability, unless the surface waters are collected in drains, pipes or ditches to be cast on the other's premises. This rule established defendant's liability. The measure of damages was the cost of restoration of plaintiff's property, in the absence of evidence of diminution of market value. (Williams-Fla)
W69-02466

WRIGHT V ROANE COUNTY (ACTION TO ENJOIN COUNTY FROM FLOODING LANDS BY ROAD CONSTRUCTION).
315 S W 2d 97-98 (Tenn 1958).

Descriptors: *Tennessee, Judicial decisions, *Jurisdiction, Highways, *Flooding, Surface runoff, Eminent domain, *Road construction, Right-of-way, Legal aspects, Remedies.
Identifiers: *Injunction, Equity.

A bill in equity was filed by a number of property owners against the county seeking relief on the ground that as a result of certain reconstruction of a federal highway, the plaintiffs' lands, which were not condemned, were being flooded. The Chancery Court dismissed the bill and the plaintiffs appealed. The Supreme Court of Tennessee held that the Chancery Court was without jurisdiction to enjoin the county to go upon the rights of way of the state and federal government and change the construction of a federal highway. If the complainants had any claim against the county, they had a plain and adequate remedy at law. (Watson-Fla)
W69-02635

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SHERMAN V STATE (CONDEMNATION VALUE OF MUCK SOILS).

174 NYS 2d 736-738 (Ct Cl 1958).

Descriptors: *Muck soils, *New York, Condemnation, Easement, *Condemnation value, Legal aspects, Judicial decisions, Highways, Crops, Vegetable crops, Drainage, *Road construction, Damages, Moisture content, Boreholes, Eminent domain.
Identifiers: Inverse condemnation.

Claimant, the owner of land appropriated by the state, brought action for compensation. The state produced experts who testified that parts of the land appropriated were 'muck lands,' unsuitable for growing crops. Claimant established by satisfactory evidence that crops had, in fact, been grown on the land. Claimant also contended that since the state constructed its road on the land, drainage has been inadequate and that the fields remain wet for a longer period than usual in the spring. The court did not attempt to classify the soil as 'muck' or 'not muck.' Claimant's damage was limited to the actual fee taking, the permanent easement, and the damage suffered by the taking of tillable acreage as it affects the total value. If, because of the construction of the new road, drainage is now inadequate and the fields remain wet for a longer period than before the appropriation, such condition would constitute a continuing trespass. (Bozarth-Fla)
W69-02640

HUIE V KLASS (COMPENSATION TO LICENSEE OF RIPARIAN OWNERS).

11 App Div 837, 202 NYS 2d 954-956 (1960).

Descriptors: *Judicial decisions, *New York, Administrative decisions, *Administrative agencies, Condemnation, *Compensation, Riparian rights, Eminent domain, Cities, Water law, Land use.
Identifiers: Permissive rights.

The New York City Board of Water Supply sought to acquire additional land and alter the flow of a river to provide an additional supply of water for the city. The commissioners of appraisal allowed damages to four claimants whose land was not taken and who had neither legal title to riparian rights in the river nor any easements. The claimants used the river water as licensees of the riparian owners and suffered a business loss due to the city's utilization of the river. The New York Administrative Code's condemnation provision, much broader than the usual condemnation statute, provided for compensation to the owner of an established business which is directly or indirectly damaged by execution of the city's plans. The Supreme Court, Special Division, issued an order pursuant to the commissioners' findings. On appeal by the Board of Water Supply, the Supreme Court, Appellate Division, held that the language of the code was sufficiently broad to require compensation for permissive rights to water exercised for business purposes. (Williams-Fla)
W69-02661

SPIELBERGER V TWELFTH DAYTON BUILDERS CORP (RIGHT OF SURFACE WATER DRAINAGE).

142 NE 2d 561-566 (C P Ohio 1956).

Descriptors: *Ohio, Judicial decisions, *Storm drains, Surface runoff, Small watershed, *Relative rights, Land use, *Natural flow, Land development, Drainage systems, Surface drainage, Ditches, Drainage water, Obstruction to flow, Legal aspects, Diversion structures.

Defendants developed, for residential purposes, lands which were higher than the lands of plaintiffs'. Defendant developers established stormwater drainage systems which increased the flow in natural and pre-existing drainage ditches, which led through the lower lands. Lower property owners brought suit for injunctive relief from damage caused by the increased flow. The Court of Common Pleas, Montgomery County, found that there had been no diversion of water on, to, or from the lands of the defendants, that the defendants were not negligent, that the use and development for residential purposes was reasonable and proper, and that the lower owners contributed to damages by failure to correct barriers and bottlenecks to the increased flow. The Court held that the right to require lower landowners to receive naturally draining surface waters is a right incident to ownership of the higher lands. The defendants were permitted to drain surface water into the natural outlets. (Wheeler-Florida)
W69-02698

KUKLINSKA V MAPLEWOOD HOMES, INC. (RIGHT OF SURFACE WATER DRAINAGE).
146 NE 2d 523-528 (Mass Sup Jud Ct 1957).

Descriptors: *Massachusetts, Judicial decisions, *Surface runoff, Prescriptive right, *Land development, Drainage systems, *Relative rights, Artificial watercourses, *Land reclamation, Surface drainage, Drainage water, Pipes, Swamps, Landfills.

Defendant developed, for residential purposes, lands located above lands of the plaintiff. Water formerly flowed through two swamps located partially on defendant's land and eventually flowed onto plaintiff's land. The defendant filled and developed the swamps and installed a concrete pipe drain to carry the flow. Defendant installed portions of the pipe through a long, pre-existing drainage ditch. The flow was discharged upon defendant's land at a point over which water formerly passed on its way to the lower lands of plaintiff. Plaintiff sued to enjoin construction of the drain which caused water to flow to the plaintiff's land. The trial court held that the drainage system did not materially increase the flow of water onto the plaintiff's land. There was evidence that the land filling actually reduced the flow. The Supreme Judicial Court held that a landowner may improve his land by changes in grade, even if the natural course of surface water is thereby changed, so long as the water is not discharged on another's land by definite, artificial channels. The Court precluded plaintiff from establishing that the discharge was through artificial channels, noting that the ditch had been present for at least 150 years. (Wheeler-Florida)
W69-02699

LA LICATA V VILLAGE OF SANDS POINT (DRAINAGE OF SURFACE WATERS).
174 NYS 2d 305-308 (Sup Ct 1958).

Descriptors: *New York, *Surface drainage, Grassed waterways, Culverts, Surface runoff, Drainage water, Precipitation excess, Legal aspects, Judicial decisions, Drainage systems, Operation and maintenance, Drainage effects, Drainage practices, *Ditches, *Conduits, Tubes, Discharge (Water), Natural flow, Grading, Embankments, Erosion, Erosion control, Topsoil, Easements.
Identifiers: Debris.

Plaintiff brought action for an injunction restraining a municipal corporation from collecting surface waters in a drainage ditch alongside a road and from discharging them upon his property. The ditch ran parallel to the boundary of plaintiff's property, and he alleges that the discharge of surface water upon his land washed away top soil and prevented seeding. Sometime after purchasing the property, plaintiff built a driveway across the ditch, obstructing the natural flow of water, thus causing it to flow to the elevation of the driveway and then run onto his land. The injunction was denied, but the court retained jurisdiction ordering the defendant to straighten, grade, and clean the ditch of debris. Plaintiff was instructed to install a conduit under his driveway and to grade up his land near the roadway so as to prevent overflowing. (Bozarth-Fla)
W69-02717

RAILROADS; DRAINS.

La R S 45:451-458 (1965).

Descriptors: *Louisiana, Adjudication procedure, Right-of-way, State governments, *Railroads, *Drainage, Topography, *Remedies, Legislation, Surface drainage, Legal aspects, Compensation.
Identifiers: Roadbeds.

All railway companies must do whatever is necessary to drain all railroad roadbeds which obstruct or interfere with the natural drainage of any land traversed by the railroad. If this is not done, the landowner may do the work at his own expense and receive reimbursement from the railway company by complying with certain statutory procedures. Provision is made for certain remedial actions and for penalties for noncompliance with the statute. (Scott-Fla)
W69-02721

PUBLIC UTILITIES - CARRIERS; RAILROADS.

La R S 45:324 (1965).

Descriptors: *Louisiana, State governments, *Roads, Transportation, Agricultural watersheds, *Drainage, Bridges, Railroads, *Navigation, Legislation.

Wherever railroads or other types of roads cross any agricultural land, said road should be constructed in such a manner so as not to interfere with drainage of the land. Should such roads cross any body or stream of water, a bridge for crossing may be erected for the exclusive use of such road so long as the bridge does not obstruct or unnecessarily interfere with navigation of such waters. (Scott-Fla)
W69-02722

IMPROVEMENTS FOR RECREATIONAL PURPOSES.
La R S 41:1505 (1965).

Descriptors: *Louisiana, Legislation, Administrative agencies, Lakes, *Permits, *Recreation facilities, State governments, *Construction, Exploitation, Leases.

The Register of the State Land Office is authorized to issue permits to make improvements for recreational purposes and to use or permit others to use such improvements. Such permits are for improvements to meandered lakes to which the state has title. All permits are subject to existing leases and wild life laws. (Childs-Fla)
W69-02723

4D. Watershed Protection

EROSION CONTROL IN RELATION TO WATERSHED MANAGEMENT,
Soil Conservation Service, Washington, D. C.
William R. Moore, and C. Edwin Smith.
Proc Amer Soc Civ Eng, J Irrig Drain Div, Vol 94, No IR3, pp 321-331, Sept 1968. 11 p, 4 fig, 2 tab, 8 ref, append.

Descriptors: *Erosion control, *Watersheds, *Erosion, Land management, Sedimentation, Soil erosion, Sediments, Runoff, Surface runoff, Losses, Benefits, Water quality, Costs, Land reclamation, Flood control, Channel erosion, Sheet erosion, *Watershed management, Small watersheds, Wind erosion.
Identifiers: Cost savings.

Erosion control is a significant factor in effective management of watershed lands. Erosion and sediment problems in the United States annually amount to over $1 billion loss or about one-fourth of all soil and water losses. Sediment problems and sources and magnitude of sheet erosion, channel erosion, and wind erosion are described. Kinds and effectiveness of land treatment measures are explained. The effectiveness and status of the small watershed approach to controlling erosion and developing water resources in these areas are set forth. Of an estimated 8300 potentially feasible small watershed projects, needed land treatment measures had been installed in 323 projects by June 30, 1966, since the enactment of the Watershed Protection and Flood Prevention Act, PL-566, in 1954. During that time, almost 6,000,000 acres had been treated with erosion control practices. Erosion control benefits from these practices and other sediment control measures are estimated to have been almost $52,000,000 by June 30, 1966. (USBR)
W69-02566

DYNAMIC PROGRAMMING METHODS APPLIED TO WATERSHED MANAGEMENT PROBLEMS,
California Univ., Los Angeles.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02622

SOIL CONSERVATION DISTRICTS (LEGISLATIVE DETERMINATIONS AND DECLARATION OF POLICY).

LSA-RS 3:1201 (1965).

Descriptors: *Louisiana, Legislation, *Soil management, *Soil erosion, Terracing, *Erosion control, Dams, Dikes, Strip-cropping, Reforestation, Run-off, Flood control, Reservoirs, Navigability, Legal aspects.

In order to conserve soil resources and control and prevent soil erosion, the legislature discourages land use policies contributing to soil wastage and erosion and recognizes that appropriate policies be carried out. Among the procedures necessary for adoption are engineering operations such as terracing, check dams, dikes, ponds, and ditches. Utilization of strip cropping, lister furrowing, contour cultivating and furrowing, land irrigation, seedling of waste or abandoned lands, and retardation of runoff are desirable. The legislature declares its policy to be: (1) to conserve soil resources; (2) to control and prevent soil erosion; (3) to control floods; (4) to prevent impairment of dams and reservoirs; and (5) to assist in the navigability of rivers and harbors. (Childs-Fla)
W69-02730

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification OF Pollutants

DIGITAL TRANSMISSION OF COLLECTED WATER QUALITY DATA,
Arkansas Univ., Little Rock. Dept. of Electronics and Instrumentation.
M. K. Testerman, R. W. Raible, and P. T. Roberson.
Arkansas Univ, Report of the Arkansas Water Resources Research Center to OWRR, Dept of Interior, September 1968.

Descriptors: *On-site data collection, Data processing, Data storage and retrieval, *Data transmission, Instrumentation, *Monitoring.
Identifiers: *Water quality data, *Digital data transmission, Design criteria, Telemetering data, Digital systems, Electronic equipment.

A system which continuously telemeters information from the remote data collection sites to a central time-shared computer, which in turn makes decisions as to whether the changes taking place are significant can be envisioned, if unlimited funds are available. Cost estimates for such a system are included along with considerations for other types of systems. Using dedicated phone lines is one means of transmitting data from remote collection sites. For many applications the cost of such a system is excessive. Interrogation at fixed intervals allows use of less expensive transmission facilities. At the remote station a programmer and timer are necessary for controlling recording sequences and interrogation is on the order of once every 24 hours. Some consideration is given to recording at preset intervals and also incorporating an alarm system for data collection at more frequent intervals. The theoretical aspects of the sampling process involved in a digital data acquisition system is discussed from the standpoint of taking the criteria and specifications of measuring water quality as set forth by the FWPCA and applying the principles of process control concepts and its attendant problems and criteria. (Roberson-Arkansas)
W69-02406

ELECTROCHEMICAL TRANSDUCERS FOR WATER QUALITY,
Arkansas Univ., Little Rock. Dept. of Electronics and Instrumentation.
C. E. Borchers, R. W. Raible, and M. K. Testerman.
In Analysis Instrumentation, Plenum Press, New York, N.Y. (1964) pp 79-82.

Descriptors: *Water quality, Water analysis, Dissolved oxygen analyzers, Water properties, *Monitoring.

Progress in the development of a self-contained remote water quality monitor is reported. Transducers suitable for this monitor are discussed and the overall monitor composition is presented. (Raible-Arkansas)
W69-02407

RESIDUES IN FISH, WILDLIFE, AND ESTUARIES,
Massachusetts Div. of Fisheries and Game; and Massachusetts Health Research Inst., Inc., Boston.
Lee D. Lyman, William A. Tompkins, and James A. McCann.
Pesticides Monitoring Journal, Vol. 2, No. 3, pp 109-122, Dec. 1968, 14 p, 2 fig, 3 tab, 8 ref.

Descriptors: *Pesticide residues, Chlorinated hydrocarbon pesticides, Fish, Gas chromatography, Chemical analysis, Water pollution.
Identifiers: *DDT, Freshwater fish, Sampling, Aquatic environment.

Fish, representing a number of indigenous freshwater species, were collected in all of the major watersheds in Massachusetts during the summers of 1965, 1966, and 1967. Individual analyses of these fish were conducted to determine the concentrations of DDT and its metabolites, DDE and DDD (TDE). A total of 1,310 individual fish specimens were collected and analyzed from 93 stations. Mean DDT concentrations, based on the analysis of a minimum of five fish per station, ranged from 0.17 to 28.88 ppm. Residues of DDT in individual fish specimens ranged from 0.00 to 49.10 ppm. Comparison of the mean concentrations of DDT between different fish species showed that some species had varying abilities to concentrate DDT. Neither length nor weight was related to pesticide concentration found in yellow perch and pumpkinseed. Some samples portrayed extreme variation in the concentration of pesticide found in individual fish. Generally, there was an increase in pesticide concentration in fish from the various watersheds of the state during the three-year study period. All data were expressed in ppm of pesticide found in whole fish, based on dry weight. Conversion factors to change ppm based on dry weight to ppm based on wet weight determined for nine species of fish. (Bridges-Mass Health Res Inst)
W69-02411

GAS CHROMATOGRAPHIC DIFFERENTIATION OF CLOSELY RELATED SPECIES OF MICRO-ORGANISMS,
New Mexico State Univ., University Park.
William Garner, and Robert N. Gennaro.
Presented to Division of Microbial Chemistry and Technology, American Chemical Society, 150th National Meeting, Atlantic City, New Jersey, Sept. 1968. 6 pp, 13 slides. OWRR Project A-002-NMex.

Descriptors: *Gas chromatography, *Bacterial identification, Bacterial fingerprinting, Digit computer identification, Water pollution, Identification of pollutants, *Pyrolysis of cells.
Identifiers: Water-borne contaminates, Gas chromatography, Bacterial identification.

Gas chromatographic detection and characterization of micro-organisms is based on the assumption that bacterial species vary both in the nature of their constituent compounds and in the relative proportions of these compounds. When these constituent compounds are converted into volatile derivatives by pyrolysis and analyzed by gas chromatography, it is possible to obtain a fingerprint of these constituents which can be converted to digital form for identification of unknown species. Widely varying species of organisms produced chromatograms with considerable differences in retention time of the peaks and relative peak heights. Chromatograms made in this study have shown that whole cells can be pyrolyzed to yield volatiles in a high degree of precision. Six species of the family Enterobacteraceae were grown on two different media. Pyrolysates from these washed, lyophilyzed cells yield chromatograms which are generally similar but in particular show a species uniqueness. These experiments should encourage continued efforts to improve and apply this technique in microbiology. (Hernandez-N Mex State)
W69-02484

POLLUTION SURVEILLANCE BY NONCONTACT INFRARED TECHNIQUES,
Texas Instruments, Inc., Dallas.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02516

ULTRAVIOLET ABSORBANCE AS AN INDEX OF THE POLLUTION OF SEAWATER,
Tokyo Metropolitan Univ. (Japan).
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02517

A COMPOSITE-GRAB OF WATER POLLUTION CONTROL SAMPLING,
Iowa State Water and Pollution Control, Ames.
For primary bibliographic entry see Field 07B.
For abstract, see .
W69-02519

LAKE ERIE REPORT: A PLAN FOR WATER POLLUTION CONTROL,
Federal Water Pollution Control Administration, Washington, D. C.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-02695

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5B. Sources of Pollution

STOCKSTAD V TOWN OF RUTLAND (OBSTRUCTION OF SURFACE WATERS).

8 Wis 2d 528, 99 NW 2d 813-817 (1959).

Descriptors: *Water pollution, Water law, Legal aspects, Judicial decisions, Local governments, *Wisconsin, Road construction, *Cities, Legislation, Deep wells, Domestic water, Ditches, Culverts, Road design, Watercourses (Legal), Obstruction to flow, Natural flow.

Defendants improved a town road abutting Plaintiffs' land. The improvements closed a pre-existing waterway and diverted its course onto Plaintiffs' premises, thereby contaminating a deep well used by the plaintiffs for domestic purposes. After drinking from the well and becoming ill with trenchmouth and other diseases, the plaintiffs instituted suit claiming defendants' actions produced a continuing nuisance and violated a state statute. The statute provided a cause of action against a town when obstruction of surface waters caused by road maintenance or construction caused damage to private property. Defendants sought to have the suit dismissed on grounds that the statute did not provide a cause of action for personal injuries. The court held that, although the complaint did not state a cause of action under the statute, sufficient facts had been stated to constitute a cause of action based upon a continuing nuisance. At common law a municipality is not immune from suit when it creates a private nuisance. (Molica-Fla)
W69-02429

DELTA-SUISUN BAY WATER QUALITY AND HYDRAULIC STUDY,
San Francisco Bay District, Vallejo, Calif. Dept. of Water Resources.
For primary bibliographic entry see Field 02L.
For abstract, see .
W69-02493

A STUDY OF SALT WATER ENCROACHMENT IN THE COASTAL AQUIFER AT DIGHA, MIDNAPORE DISTRICT, WEST BENGAL, INDIA,
Geological Survey, Calcutta (India).
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-02504

THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,
Kansas Univ., Lawrence, Kans.
Raymond C. Loehr.
Proceedings of the Third Annual American Water Resources Conference, 1967, pp 314-324, 11 p, 2 fig, 2 tab, 28 ref.

Descriptors: *Animal wastes, Wastes, Water pollution sources, Cattle, Fishkill, Waste disposal, Kansas, Runoff, Nitrogen, Drainage, Diseases, Water pollution effects.
Identifiers: Animal production trends, Animal confinement trends, Organic pollution, Inorganic pollution.

Until recently animal wastes have been considered as part of the 'natural' pollution of a region. Animal production is changing from small farm operations into large scale industrial enterprises. There is an increasing trend to confine animals within small areas to produce the greatest weight gain in the shortest period of time. Under such conditions, it is not possible for these animals to drop their wastes on pastures where the wastes can be absorbed by nature without adversely affecting the environment. Animal wastes have been shown to be a major source of surface water pollution. This paper mentions cases of pollution that have been caused by animal wastes and animal production operations. It discusses the trend toward confinement feeding operations and the magnitude of the problem in the future. It also demonstrates the need to consider animal wastes when developing or protecting water resources. (Seneca-Rutgers)
W69-02528

ASYMMETRY BETWEEN BRIBES AND CHARGES,
Carnegie Inst. of Tech., Pittsburgh, Pa.
M. I. Kamien, N. L. Schwartz, and F. T. Dolbear.
Water Resources Research, Vol 2, No 1, pp 147-157, First Quarter 1966. 11 p, 2 fig, 14 ref, 3 append.

Descriptors: *Wastes, Waste disposal, Streams, Costs, *Water pollution, Water treatment, Marginal costs, Waste treatment, Profit.
Identifiers: *Asymmetry, *Bribes, *Charges, *Externalities, Comparative statics, Boundary solution, Interior solution.

A classic and increasingly important example of the technological externalities problem is that of a firm discharging waste into a stream, thereby inflicting damages on downstream users of the water. As long as there is no economic or legal incentive to do otherwise, the firm will ignore the effects of this action on others. It has been argued that, asymmetries in income distribution and administration aside, the levying of a charge and the payment of a bribe are symmetric means of internalizing to the firm the externality resulting from its discharge of waste into the stream. It is shown that this symmetry between bribes and charges does not hold when the cost and revenue functions are subject to change, unless these functions are known by the affected parties. Furthermore, a bribe will not only cause the firm to produce at least as much waste matter as under a charge alternative of the same cost but may even induce the firm to produce more waste matter than in the absence of a bribe or a charge. The analysis deals with water pollution for the sake of exposition; the analysis can be extended readily to other situations giving rise to externalities. (Seneca-Rutgers)
W69-02534

EFFECT OF RIVER WATER QUALITY ON AN ADJACENT AQUIFER,
Cincinnati Univ., Ohio.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-02611

UNITED STATES V REPUBLIC STEEL CORP (DUMPING OF INDUSTRIAL SOLIDS AND FLUE DUST IN CHANNEL OF NAVIGABLE RIVER).

264 F 2d 289-304 (1959).

Descriptors: *United States, Judicial decisions, Water Law, Rivers and Harbors Act, Legislation, *Navigable waters, *Industrial wastes, Sediment discharge, Channel, *Obstruction to flow, Rivers, Sewers, Dredging, Excavation, Wastes, Riparian rights, Legal aspects.
Identifiers: Army Corps of Engineers, Debris.

The United States brought this action to enjoin the discharge of industrial solids and flue dust into the channel of a navigable river and for a mandatory injunction directing that the channel be dredged to the original depth. This is an appeal from a judgment for the United States. The court of appeals held that the deposit of the industrial solids and flue dust did not constitute an 'obstruction' within the meaning of the Rivers and Harbors Appropriation Act of 1899, and did not constitute a 'fill' within the meaning of the provision of that section in the Act, nor did it constitute a violation of the section making unlawful the deposit in navigable waters of any refuse matter. Thus, the United States was not entitled to an injunction under the Act or independent of statuatory power. The judgment was reversed. (Childs-Fla)
W69-02651

CLOGGING AND CONTAMINATION PROCESSES IN RECHARGE WELLS,
Technion Israel Institute of Tech., Haifa; and Water Planning for Israel Ltd., Tel Aviv.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-02669

MODEL EXPERIMENTS ON FLUID FLOW IN THE TRANSITION ZONE FROM UNSATURATED TO SATURATED SOIL,
Bundesanstalt fuer Gewasserkunde, Coblenz, (West Germany).
For primary bibliographic entry see Field 02G.
For abstract, see .
W69-02681

5C. Effects of Pollution

RESIDUES IN FISH, WILDLIFE, AND ESTUARIES,
Massachusetts Div. of Fisheries and Game; and Massachusetts Health Research Inst., Inc., Boston.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-02411

FRIESLAND V CITY OF LITCHFIELD (DAMAGES FROM UNTREATED SEWAGE).

24 Ill App 2d 390, 164 NE 2d 606.

Descriptors: Water law, *Fouling, Accident, Sewage, *Water pollution sources, Water pollution effects, *Illinois, Judicial decisions.

Defendant city permitted untreated sewage to flow into a creek which crossed plaintiff's land thereby poisoning his cattle. Plaintiff obtained a judgment in the trial court for his losses and defendant city appealed, assigning inter alia error in admitting certain expert testimony. The testimony dealt with samples of water taken from the creek some two months after the plaintiff moved from the property. The admission of the testimony was upheld. The interceptor sewer system which ran parallel to the ditch which eventually entered plaintiff's land had ruptured and allowed raw sewage to enter the ditch. It was also shown that the city had notice of the rupture in the system. (Dann-Fla)
W69-02434

EUTROPHICATION OF WATER RESOURCES OF NEW YORK STATE. A STUDY OF PHYTOPLANKTON AND NUTRIENTS IN LAKES CAYUGA AND SENECA,
New York State Coll. of Agriculture, Ithaca.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-02488

PIGMENT INDICES AND ENVIRONMENTAL OXYGEN STRESS,
North Carolina Univ., Chapel Hill. Water Resources Research Inst.
Robert A. Kelly.
Report 12, 1 Oct 1968. 94 p. OWRR Project A-025-NC.

Descriptors: *Water pollution effects, *Bioindicators, *Streams, *Oxygen requirements, *Benthic fauna, *Pigments, Eutrophication, Oligotrophy, Spectrophotometry, Analytical techniques, Water pollution sources, Metabolism, Environmental effects, Aeration, Physiology, North Carolina, Water quality, Respiration, Bioassay.
Identifiers: Middle Creek (NC), Reeds Creek (NC), Alamance Creek (NC), Big Alamance Creek (NC), Morgan Creek (NC), Ledge Creek (NC), Kenneth Creek (NC), Eno River (NC), New Hope Creek (NC), Ellerbe Creek (NC), Northeast Creek (NC), Robeson Creek (NC), Walnut Creek (NC), Marlowes Creek (NC), Loves Creek (NC), Richland Creek (NC), Town Creek (NC), North Rock River (NC), Saprobe system, Diversity indices, Hemoglobin indices, Beck's biotic index.

Samples of benthic animals, taken from 41 stations located above and below sources of organic wastes entering 18 North Carolina streams, were homogenized, centrifuged, and examined spectrophotometrically for presence and relative concentrations of hemoglobin. Relative low oxygen values were estimated from determinations made at night in spring (39 stations) and summer (30 stations). Four pigment indices were calculated from absorbances at peak wavelengths characteristic for hemoglobin using the following relationships: INDEX ONE= C - (0.6 (B + D)); INDEX TWO= (C - (0.6 (B + D)))/G; INDEX THREE = 1.05 A + 2.50 C - 3.55 B; and INDEX FOUR = (1.05 A - 2.50 C - 3.55 B)/G; where A, B, C , and D are absorbances at 405, 500, 540, and 600 millimicrons, respectively, and G is wet weight (grams) of animals in the sample. A trend, not statistically significant, of association of higher hemoglobins with areas with organic wastes and low oxygen was demonstrated. Non-hemoglobin body pigments were found in streams with low concentrations of organic wastes. Data suggested an inverse relationship between non-hemoglobin pigments, found principally in streams with high oxygen concentrations, and hemoglobin pigments. Appendices contain extensive data by stations for absorbances, pigment indices, and dissolved oxygen and figures of absorption spectra by stations.
W69-02521

ECOLOGICAL SYSTEMS ANALYSIS AND WATER QUALITY,
Oak Ridge National Lab., Tenn.
Bernard C. Patten.
Systems Approach to Water Quality in the Great Lakes, Proc 3rd Annu Symp Water Resources Res, pp 37-45, Ohio State Univ, Sept 1967. 9 p, 18 ref.

Descriptors: *Ecological distribution, Optimization, *Systems analysis, *Water quality, Linear programming, *Mathematical models, Environmental effects, Ecosystems, Growth rates, Analytical techniques, Aquatic environment, Fluctuation, Ecology.
Identifiers: Optimum diversity, Dynamic behavior.

Several examples of environmental energy and material transfer problems were mathematically structured to illustrate some recent applications of systems analysis techniques to ecological problems. A system defined as a set of simultaneous differential equations was rewritten in matrix form. It was shown that the 'eigenvector' solution to the problem could be used to determine the transient response to disturbances, the stability, parametric sensitivity and the optimality of the system. Simplified example solutions of the technique were tabled. Single resource-single species, and single resource-multiple species population growth rate equations were defined. The analogy of optimum diversity of species problems to 'shortest route' and 'maximum flow' linear programming network problems was illustrated by a simple example. A species diversity index equation was suggested as a possible method of evaluating water quality. (Gysi-Cornell)
W69-02613

OXYGEN DEMAND AND OXYGEN DEPLETION CAPACITY OF SEDIMENTS FROM WASSAW SOUND, GEORGIA,
Georgia Univ., Athens.
Dirk Frankenberg, and Charles W. Westerfield, Jr.

Bull of Georgia Acad of Sci, V 26, No 4, pp 160-172, Sept 1968. 13 p, 4 tab, 3 chart, 32 ref.

Descriptors: *Sediments, *Estuaries, *Oxygen demand, Salt marshes, Phosphates, Mining, Georgia, Hydrography, Ecosystems, Tidal waters, Tidal marshes.
Identifiers: Oxygen depletion capacity, Water quality deterioration, Organic-rich sediments, Wassaw Sound (Georgia).

Proposed mining of phosphate deposits lying 70 to 120 ft beneath salt marshes and estuaries of Wassaw Sound, Georgia poses a problem of potential damage to the salt marsh-estuarine ecosystem. Oxygen relationships of water and sediments from Wassaw Sound were studied to determine potential oxygen-depleting effects of disturbing large quantities of organic-rich sediments. Data collected, evaluated, and tabulated include surface water hydrographic parameters in addition to sediment oxygen demand and depletion capacity. The study shows that the average oxygen demand of sediments from creek bottoms, marshes, creek banks, river bottoms and sound bottom were, respectively, 3.73, 3.25, 2.10, 2.08, and 0.89 mg oxygen per cc sediment during the first 24 hours after disturbance. Conjunctive average oxygen depletion capacities were 986, 766, 515, 477, and 154 cc water depleter per cc of sediment disturbed during the first 24 hours after disturbance. Conclusions of study suggest strongly that severe oxygen depletion of waters in Wassaw Sound could result from disturbance of the sediments. Estimates of oxygen demand liberated by disturbance of sediments attributed to specified mining operations indicate that all the oxygen could be removed from 16 to 27 percent of the low tide volume of Wassaw Sound and its tributaries. (Steinhilber-USGS)
W69-02673

LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT,
Arizona Univ., Tucson. Cooperative Fishery Unit.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-02687

LAKE ERIE REPORT: A PLAN FOR WATER POLLUTION CONTROL,
Federal Water Pollution Control Administration, Washington, D. C.

Fed Water Pollut Contr Admin, Great Lakes Reg, 107 p, Aug 1968. 52 fig, 16 tab, 1 append.

Descriptors: *Lake Erie, *Water pollution effects, *Eutrophication, *Water pollution control, Water quality control, Hydrogeology, Limnology, Municipal wastes, Dredging, Industrial wastes, Great Lakes.

Detailed descriptions of water pollution of Lake Erie, strong recommendations for correction, and descriptions at the Lake, Lake basin, and the urban areas of the Lake Erie area are presented. Lake Erie and its drainage basin support over 13 million people. Manufacturing adds 17 billion dollars a year to the economy of the U. S. and Canada. The Lake water itself is used for water supply, recreation, commercial fishing, and shipping. The lake has too many nutrients from pollution. Bottom oxygen is depleted in summer. Fish quality is declining. Algae cause bad tastes and odor and litter shorelines with decomposing organic matter. Bacterial contamination closes swimming beaches. Silt from channel dredging carries oxygen demand to dumping areas where it would otherwise be lower. The main pollution source areas are Detroit, Cleveland, and the Maumee River Basin. Phosphorus, the principal cause of algae problems, is 72% from municipal wastes, 17% rural, 7% industrial, and 7% urban runoff. The cost of waste treatment to stop the pollution is estimated at $1.1 billion for municipalities and $285 million for industry. Standards for streams entering Lake Erie have been set. (Knapp-USGS)
W69-02695

EFFECTS OF PESTICIDES ON FRESHWATER ORGANISMS,
Clemson Univ., Clemson. Dept. of Entomology and Zoology.
John K. Reed, Lamar E. Priester, and Rudolph Prins.
Water Resources Institute, Technical Completion Report May 1, 1965 - June 30, 1968. 31 p, 4 tab. OWRR Project A-001-SC.

Descriptors: Algae, Protozoa, *Aquatic insects, *Aquatic drift, Fish food organisms, Fish physiology, Fish taxonomy, DDT, Phosphothioate pesticides, Herbicides, *Pesticide residues, Diatoms, Crayfish, Pollutant identification, *Water pollution effects, Gas chromatography.
Identifiers: South Carolina, Lyophilization, *Pesticide metabolism, *Pesticide accumulation.

Lists of arthropods, reptiles, amphibians and fish found in northwestern South Carolina streams by the authors are given. The ecology of these forms was affected by the presence of organic pesticide pollution in certain streams. The pollutants found were DDT, DDE, BHC, toxaphene, aldrin and dieldrin. The highest level of pesticide was in the organisms, then bottom mud with the least in water. Laboratory studies showed selected species of algae and protozoa concentrated DDT and parathion from water but breakdown products were not detectable. Trifluralin was both concentrated from water and metabolized by goldfish. Drifting food organisms of fish in the field were found to be influenced by the season of the year, weather, and pollution.
W69-02782

DETERMINATION, EVALUATION AND ABATEMENT OF COLOR IN TEXTILE PLANT EFFLUENTS,
Georgia Inst. of Tech., Atlanta, Ga.
R. K. Flege.
Georgia Institute of Technology Water Resources Center, Report No. WRC-0868, Dec 1968. 68 p, 3 fig, 4 tab, 18 ref, 3 append. OWRR Project B-012-Ga.

Descriptors: *Dye releases, *Textiles, *Textile waste effluents, Chromatography, *Waste water treatment, *Surfactants, Linear alkylate sulfonates, Biodegradation, Turbidity, Toxicity, *Water quality control, *Color, Foaming, Metabolism, Georgia, Dissolved oxygen, Oxidation lagoons, Industrial wastes.

Report is based on and summarizes data included in 4 M.S. theses: Forecasting Quantities of Dyestuffs and Auxiliary Chemicals Discharged into Georgia Streams by the Textile Industry, by L. G. Arnold; Color Evaluation in Effluents from Textile Dyeing and Finishing Processes, by W. S. Hood; The Degradability of Surfactants in Textile Mill Wastes with Hydrogen Peroxide, by D. N. Nonaka; and A Study of the Degradation of Some Azo Disperse Dyes in Waste Disposal Systems, by H. D. Pratt, Jr. Report finds, in part, that color in streams is a powerful index of the presence of pollutants; the presence or absence of color in streams is not an adequate criterion for evaluating the serious nature of pollution that results from receiving dyes and their companion colorless dye-like auxiliaries used for chemical control in dyeing processes; color in dyehouse waste may be significantly reduced by conventional waste treatment processes; that degradation of dyes in mill effluent in streams and treatment plants may result in metabolites that are more damaging to life processes than dyes; that some dyes are toxic to biota in activated sludge treatment plants; and that digestion of some dyes in conventional waste-treatment plants results in degradation products recognized to be carcinogenic.
W69-02792

NITROGEN FIXATION AND THE UTILIZATION OF OTHER INORGANIC NITROGEN SOURCES IN A SUBARCTIC LAKE,
Alaska Univ., College, Inst. of Marine Science.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-02795

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5D. Waste Treatment Processes

ELECTIVE DEDUCTION AND EXEMPTION FOR CONSTRUCTIONS OR IMPROVEMENT OF INDUSTRIAL WASTE TREATMENT FACILITIES.

Mass Ann Laws, ch 63 sec 38D (1967).

Descriptors: *Massachusetts, Legislation, *Taxes, *Industrial wastes, Industrial plants, *Treatment facilities, Water pollution control, Water quality, Waste treatment, Water treatment, Effluents.
Identifiers: Tax advantages.

A deduction in determining net income subject to tax is allowed to any corporation for expenditures paid or incurred during the taxable year for construction or improvement of industrial waste treatment facilities. 'Industrial waste treatment facilities' and 'industrial waste' are defined. The deduction is allowed only for depreciable tangible property which is used in the trade or business of the tax payer and has a situs within the state. The facilities must be certified as complying with the water pollution control law by the Director of the Division of Water Pollution Control of the Department of Natural Resources. Provisions are made for corporations which begin to use their facilities for the salvage of by-products and which do not obtain a permanent certificate of compliance for such facilities. The deduction may not be used to compute the basis of the property upon sale or exchange thereof. Basis must be computed as if straight-line depreciation had been used. Facilities qualifying for the deduction are exempted from certain excise taxes. (Williams-Fla)
W69-02461

THE OPTIMAL ALLOCATION OF STREAM DISSOLVED OXYGEN,
Johns Hopkins Univ., Baltimore, Md.; and Cornell Univ., Ithaca, N. Y.
Jon C. Liebman, and Walter R. Lynn.
Water Resources Research, Vol 2, No 3, pp 581-591, Third Quarter 1966. 11 p, 5 fig, 5 tab, 11 ref.

Descriptors: *Dissolved oxygen, Effluents, Dynamic programming, Costs, Waste treatment, Streams, Water quality, River basins, Linear programming, Biochemical oxygen demand, Streamflow.
Identifiers: *Optimal allocation, Willamette River, Stream standard, Effluent standard, Concentration standards.

A dynamic programming model that minimizes the cost of providing waste treatment to meet specified dissolved oxygen concentration standards in a stream is developed. The model is solved for a simplified example based on data from the Willamette River. Implications of the model on policy formulation are discussed. (Seneca-Rutgers)
W69-02530

CONTROL OF MINE DRAINAGE WATER,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02539

DYNAMIC ECONOMIC EFFICIENCY OF WATER QUALITY STANDARDS OR CHARGES,
Washington Univ., Seattle.
Gardner Brown, Jr., and Brian Mar.
Water Resources Research, Vol 4, No 6, pp 1153-1159, December 1968. 7 p, 8 fig, 6 ref.

Descriptors: *Water quality, *Economic efficiency, Water pollution, Waste treatment, Administration, Effluents, Standards.
Identifiers: *Demand function, *Damage function, *Waste discharge function, Water quality charges, Stream standards.

If a manager of a given water resource is uncertain of his power to set optimum stream standards or optimum effluent charges at every moment in time, there exist conditjons, qualitatively identified, under which it may be dynamically more efficient for him to establish present water quality levels that will be optimum only at some future date than to try unsuccessfully to achieve optimum levels at every point in time. Excess demand functions and an aggregate nonlinear damage function are the conceptual underpinnings of this paper. (Seneca-Rutgers)
W69-02549

AMORTIZING WASTE TREATMENT FACILITIES.

N C Gen Stat sec 105-130, 10 (1967 Supp).

Descriptors: *North Carolina, Legislation, Legal aspects, Administrative agencies, Local governments, *Taxes, *Depreciation, *Amortization, Sewage systems, Treatment facilities, Water pollution, Pollution abatement, Permits.
Identifiers: Board of water and air resources.

At the option of the corporation, in lieu of any depreciation allowance, a deduction shall be allowed for amortization of the cost of any sewage or waste treatment plant, including waste lagoons and pollution abatement equipment, which reduces the amount of water pollution resulting from the discharge of sewage and industrial wastes, based on a period of 60 months. The procedures for obtaining this allowance are stated. (Childs-Florida)
W69-02705

TAX EXEMPTION OF REAL PROPERTY USED FOR AIR OR WATER POLLUTION ABATEMENT FACILITIES.

N C Gen Stat sec 105-296 (11) (1964).

Descriptors: *North Carolina, *Legislation, Administrative agencies, Local governments, *Taxes, *Treatment facilities, Real property, Water pollution, Permits, Pollution abatement.
Identifiers: Tax exemption.

Real property, or that part which is used exclusively for air cleaning or waste disposal or air or water pollution abatement facilities, including waste lagoons, is exempt from taxation. The procedures for obtaining this exemption are provided by the statute. (Childs-Florida)
W69-02706

TAX EXEMPTION OF REAL PROPERTY USED FOR AIR OR WATER POLLUTION ABATEMENT FACILITIES.

N C Gen Stat sec 105-296 (11) (1967 Supp).

Descriptors: *North Carolina, Legislation, Legal aspects, Administrative agencies, Local governments, *Taxes, Treatment facilities, *Real property, Air pollution, Water pollution, Pollution abatement, Permits.
Identifiers: Tax exemption.

Real property, or that part which is used exclusively for air cleaning or waste disposal or air or water pollution abatement facilities, including waste lagoons, is exempt from taxation. The procedures for obtaining this exemption are provided. (Childs-Florida)
W69-02707

WATER AND SEWER SANITATION.

N C Gen Stat sec 130-161, 130-165 (1967 Supp).

Descriptors: *North Carolina, Legislation, Administrative agencies, *Regulation, *Environmental sanitation, *Sewage treatment, Water supply, Municipalities, Drainage, Sewers, Water purification, Surveys, Military reservations.
Identifiers: State Board of Health.

The State Board of Health is to advise and consult with those having, or intending to introduce, systems of water supply, drainage, or sewerage, or intending to make major alterations of such systems, so as to ascertain the most appropriate source of supply, the best method of assuring the purity thereof, and the most advantageous means of disposing of their drainage or sewerage. No introduction or alteration of a system will be allowed until the State Board of Health has approved the project. The act prohibits the discharge of sewage or industrial waste above the intake into any source from which a public drinking water supply is taken unless such waste has been passed through some approved system of purification. (Childs-Florida)
W69-02710

5E. Ultimate Disposal of Wastes

PROGRESS IN THE UNITED STATES OF AMERICA TOWARD DEEP-WELL DISPOSAL OF LIQUID AND GASEOUS RADIOACTIVE WASTES,
Geological Survey, Washington, D. C.
A. Clebsch, Jr., and E. H. Baltz.
Symp on Int At Energy Agency, Vienna, and Europe Nucl Energy Agency, May 29-June 2, 1967, pp 591-605, 1967. 15 p, 33 ref.

Descriptors: *Injection wells, *Radioactive waste disposal, United States, Observation wells, Pumping, Safety, Water quality, Aquifers, Aquicludes, Aquifer characteristics, Mathematical models.
Identifiers: Waste gas injection.

The basic technology for deepwell disposal of liquid wastes developed and used by the petroleum industry and adapted by the chemical industry is discussed. Requirements for disposal of radioactive wastes include an understanding of physical and geologic characteristics of the disposal reservoir, effects of chemical reactions between waste and reservoir rock, and hydraulic effects of long-term injection on rate and direction of mass transport and integrity of geologic units bounding the disposal reservoir. Deep-well disposal is not feasible at many existing waste-generating sites because of unsuitable geologic environments. Gas injection research concerns rapid disposal of relatively large volumes of fission-products into water-saturated or unsaturated rocks. Mathematical models of gas flow, definition of the problems of dispersion, laboratory studies of gas sorption on earth materials, the role of barometric changes in bringing injected gases back into the atmosphere, engineering and economic evaluations, and field tests of the method have all been studied. As a safeguard for the rapid disposal of fission-product gases and other gases after major reactor accident, the injection method is severely limited in saturated rocks by dependence on favorable hydrogeologic conditions, the need to prepare the disposal reservoir in advance and maintain it by continuous injection of air, and the cost. The prospects are better for using the method in unsaturated rocks and for routine disposal of waste gases that can be separated as a low-volume stream. (Knapp-USGS)
W69-02688

SCIENTIFIC PREREQUISITES FOR UTILIZING DEEP-LYING FORMATIONS FOR BURYING LIQUID RADIOACTIVE WASTES,
Akademiya Nauk SSSR, Moscow. Institut Fizicheskoi Khimii.
V. I. Spitsyn, M. K. Pimenov and F. P. Yudin.
Proc of Symp, Int At Energy Agency, Vienna, and Europe Nucl Energy Agency, May 29-June 2, 1967, pp 563-576, 1967. 14 p, 2 fig, Discuss.

Descriptors: *Injection wells, *Radioactive waste disposal, Observation wells, Pumping, Safety, Water quality, Aquifers, Aquicludes, Aquifer characteristics.

The Soviet Union is pursuing several lines of research on disposal of liquid radioactive wastes,

including the injection of wastes into deep geological formations. The use of porous water-bearing strata in the earth's crust far enough below the surface and isolated above and below by thick strata of species that are impermeable to water is considered. The main features and methods of hydrogeological surveying and the various research projects that are necessary to ensure health and radiation safety are described, and a number of questions relating to the physico-chemical processes which occur in absorbing strata when radioactive waste is injected into them are considered. The processes discussed include migration, radiolysis, evolution of gas and heating of the surrounding medium. It is shown that, under particular geological conditions, deep burial of radioactive waste affords a promising means of disposal that ensures health and radiation safety and is at the same time economically advantageous. It is also demonstrated that the waste is distributed over a limited area of the stratum, which involves no serious changes in the hydrogeological pattern of the region and so does not prevent the formation from being used for other purposes. (Knapp-USGS)
W69-02692

EXEMPTION FROM TAXATION OF TREATMENT FACILITIES.
N C Gen Stat sec 105-297 (16) (1964).

Descriptors: *North Carolina, Legislation, Administrative agencies, Regulation, Local governments, *Taxes, Sewage, Wastes, *Treatment facilities, Permits, *Pollution abatement.
Identifiers: Tax exemption.

Sewage and waste treatment facilities, and water pollution abatement equipment designed to abate or reduce water pollution are exempt from taxation. The procedures for obtaining this exemption are described. (Childs-Florida)
W69-02703

5F. Water Treatment and Quality Alteration

ACQUISITION OF ADDITIONAL WATER RIGHTS - ENLARGEMENTS, PURIFICATION PLANT.

N Y Village Law sec 225 (McKinney 1966).

Descriptors: *New York, *Legislation, Water law, Administrative agencies, Cities, Water rights, Water sources, *Water supply, Water storage, Reservoirs, Water purification, Water treatment, *Water works, Legal aspects.

The board of trustees of a village may, by resolution, determine to purchase or acquire additional water or water rights, construct or add to a water purification or treatment plant, construct additional reservoirs, or otherwise increase the system of water for the village. The resolution must state the maximum sum to be appropriated. The board has the same power and duties regarding the new construction as it possessed in the construction of the original system of water works. (Watson-Florida)
W69-02697

TRANSPORT OF ELECTROLYTES THROUGH MEMBRANE SYSTEMS,
Southern Research Inst., Birmingham, Ala.
Robert E. Lacey.
Office of Saline Water Research and Development Progress Report No. 343, March, 1968. 101 p. OSW-14-01-0001-464.

Descriptors: *Ion transport, *Electrodialysis, *Permselective membranes, Diffusion, Osmosis, Electroosmosis, Transport depletion, Semipermeable membranes, Demineralization, Theoretical analysis, Membrane processes.
Identifiers: *Irreversible thermodynamics, Admittance coefficients, Membrane synthesis, Water transport.

Experimental methods were developed to measure with acceptable accuracy six independent transport characteristics that are needed to describe the transport of ions and water through membrane systems. The experimentally determined values of the six transport characteristics were used to calculate the admittance coefficients for the classical phenomenological equations for membrane transport systems. Seven-cellulosic membranes were studied, and the effects of changes in solution concentration on the admittance coefficients and the friction factors were determined for four of them. In addition, the effects of changes in current density of the admittance coefficients were determined for these four membranes. The admittance coefficients and friction factors determined with the aid of the new techniques were used to calculate for specific demineralization situations the portions of the total flux of ions and water that result from individual driving forces (e.g., diffusive, osmotic, and electro-osmotic fluxes), and the degrees of interaction between moving species. It was demonstrated that the fluxes and interactions, so calculated, can show the sources of discrepancies between actual demineralization performance and performance predicted by the methods in use prior to the present research. In addition to the major efforts described above, brief studies were made of two new methods of preparing ion-selective membranes. (Scott-OSW)
W69-02783

EFFECTS OF ARTIFICIAL FERTILIZATION ON PLANKTON AND BENTHOS ABUNDANCE IN FOUR EXPERIMENTAL PONDS,
Oregon State Univ., Corvallis. Dept. of Fish and Game Management.
David C. McIntire, and Carl E. Bond.
Trans Amer Fish Soc, Vol 91, pp 303-312, 1962. 10 p, 6 fig, 6 tab, 9 ref.

Descriptors: *Eutrophication, *Fertilization, *Fish food organisms, *Bioindicators, Crustaceans, Rotifers, Diatoms, Midges, Dragonflies, Ponds, Water quality, Water pollution effects, Nutrients, Plankton, Benthos, Chlamydomonas, Phosphorus, Nitrogen.
Identifiers: Lepomis, Micropterus, Bosmina, Cyclops, Chydorus, Diaphanosoma, Polyarthra, Keratella, Brachionus, Conochilus, Asplanchna, Closterium, Cosmarium, Eudorina, Micractinium, Pandorina, Staurastrum, Phacus, Trachelomonas, Dinobryon, Gymnodinium, Cryptomonas, Oedogonium, Gordius, Cryptophyceae, Desmids.

Before fertilization, four experimental ponds near Corvallis, Oregon, were characterized by low concentrations of nitrogen and phosphorus, pH values near neutrality, low total alkalinities, and nearly saturated concentrations of dissolved oxygen. Monthly from March to October 1959, ponds were treated as follows: Pond 1 received no fertilizer; Pond 2 received 16.7 pounds of urea (as source of nitrogen); Pond 3, 16.7 pounds of urea and 25.0 pounds of single super phosphate; and Pond 4, 33.4 pounds of urea and 50.0 pounds of single super phosphate. In fertilized ponds, chemical and physical conditions were altered considerably, and large populations of phytoplankton and zooplankton were produced. Benthic communities developed after the establishment of planktonic populations, especially in two ponds receiving nitrogen and phosphorus. The benthic community developed most rapidly, and with greatest biomass, in the pond receiving heaviest application of both fertilizers. Benthic production was low in ponds which received no phosphorus. Concentrations of dissolved oxygen remained near saturation for unfertilized pond, but fertilized ponds were characterized at some time by reduction of oxygen due to decomposition of planktonic organisms.
W69-02788

5G. Water Quality Control

WATER AND WATER RIGHTS - WATER POLLUTION AND QUALITY CONTROLS,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3 - Water Pollution and Quality Controls, 1967, 540 p.

Descriptors: *Water pollution, *Water quality, *Riparian rights, Water rights, Invasion, Remedies, Damages, *Legislation, Legal aspects, Federal government, Administrative agencies, Abatement, Standards, Mexican water treaty, Rivers and harbors act, Jurisdiction, State governments.
Identifiers: FWPC Act, Injunction, Defenses, Oil pollution act.

This volume contains chapters 12-15. Chapter 12 deals with the problems and solutions of water quality controls. It discusses physical and chemical properties affecting water quality, natural quality of water, sources and means of water pollution, evaluation of water quality, and the history of water quality control laws. Chapter 13 deals with water quality controls enforceable under state law. Chapter 14 covers state administrative regulation of water quality. Chapter 15 examines water quality control in federal jurisdictions with emphasis on the Federal Water Pollution Control Act of 1948. (Watson-Fla)
W69-02414

ASSISTANCE RENDERED UNDER THE FWPC ACT,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 249, pp 404-408, 1967. 5 p.

Descriptors: Water quality, *Water pollution, *Federal government, *Legislation, Administrative agencies, Abatement, Reservoir construction, Watersheds (Basins), Wastes, *Financing, Grants, Taxes, Sewage treatment.
Identifiers: FWPC Act.

The FWPC Act provides both financial and technical assistance. The primary financial incentive provisions of the act are in sections 3, 5-8, and 18. Section 3 (b) (4) provides that when the water quality control features incorporated in any federal reservoir provide benefits that are widespread or national in scope, the costs of such features shall be nonreimbursable. Section 3 (c) authorizes the Secretary to make a grant of up to 50% of the administrative expenses of a planning agency, for a period up to three years, for the development by that agency of a comprehensive pollution control and abatement program for a basin. Section 5 (a) (2) authorizes the Secretary to make grants-in-aid for research or training projects and for demonstrations. Section 6-8 provide grants for research, training of personnel, and construction of treatment plants for the control of waste. Section 18 directs the Secretary to use financial stimulae, including tax incentives, to promote the construction of waste-treatment facilities. The Act has many provisions to provide technical assistance for studies and research in the area of water quality and pollution control. (Watson-Fla)
W69-02415

ENFORCEMENT PROCEEDINGS UNDER THE FEDERAL WATER POLLUTION CONTROL ACT,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 248, pp 381-404, 1967. 24 p.

Descriptors: Water quality, *Water pollution, Federal government, *Legislation, Administrative agencies, *Abatement, Navigable waters, Interstate rivers, Jurisdiction, *Standards, Conferences.
Identifiers: FWPC Act.

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Section 10 of the FWPC Act contains provisions for administrative regulation and enforcement proceedings and for judicial enforcement proceedings in regard to water quality and pollution control. Two types of proceedings are available: (1) water pollution abatement proceedings, which have been in the act since its enactment in 1948; and (2) water quality standards proceedings, which were added to the act in 1965. Pollution abatement consists of three stages of enforcement procedures: (1) Conference, (2) Public hearing, and (3) Court action. Pollution abatement proceedings may be used against the pollution of any navigable water, whether interstate or intrastate. The water quality standards proceedings consist of three stages -- (1) establishment or revision of standards, (2) informal hearing, and (3) court action. In regard to interstate waters for which water quality standards have not yet been established, only the water pollution abatement procedures are available. Water quality standards are applicable only to interstate waters. (Watson-Fla)
W69-02416

ADMINISTRATIVE AGENCIES - JURISDICTION - UNDER THE FEDERAL WATER POLLUTION CONTROL ACT,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality controls, Chapter 15, Sec 246-247, pp 364-381, 1967. 18 p.

Descriptors: Water quality, *Water pollution, *Federal government, *Legislation, Administrative agencies, Abatement, Navigable waters, Interstate rivers, *Jurisdiction.
Identifiers: FWPC Act.

The FWPC Act is implemented through the FWPC Administration which is in the Department of the Interior. Activities undertaken pursuant to the FWPC Act may affect various water sources in the United States, depending upon the nature, purpose, and source of initiation of the particular activity involved. There appears to be little, if any, limitation on the waters that may be considered under the technical or financial provisions of the act. The water-quality standards of the act apply only to interstate waters. However, the pollution abatement provisions apply to all navigable waters whether interstate or intrastate. The basic purposes of the FWPC Act are to enhance water quality and to establish a national policy of water pollution control. What is considered water pollution, however, varies according to which provisions of the act are being applied. For the purpose of administrative or judicial enforcement, the term water pollution is somewhat more restricted than the meaning given to that term for study or financing purposes. (Watson-Fla)
W69-02417

THE FEDERAL WATER POLLUTION CONTROL ACT OF 1948 - INTRODUCTION,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 245, pp 359-364, 1967. 6 p.

Descriptors: Water quality, *Water pollution, *Federal government, *Legislation, *Administrative agencies, Navigable waters, Abatement, Interstate rivers.
Identifiers: FWPC Act.

The FWPC Act is the most important federal statute dealing with water quality and water pollution. The stated congressional purpose of the act is to enhance the quality and value of our water resources and to establish a national policy for water pollution control. The act recognizes the primary responsibilities and rights of the states in this field and establishes the policy of providing technical and federal aid to states, interstate agencies, and municipalities. The act provides tools for attacking water pollution and for preserving and enhancing water quality. Administrative and judicial enforcement procedures, with primary emphasis on voluntary compliance during the administrative phases are established, and co-operation with and among federal agencies is encouraged. Studies, reports, investigations, demonstrations, and other forms of technical assistance are provided to identify pollution and to pinpoint a means of pollution control. (Watson-Fla)
W69-02418

GENERAL FEDERAL LEGISLATION RELATING TO WATER QUALITY,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 244, pp 354-358, 1967. 4 p.

Descriptors: *Water quality, *Federal government, Oil, Water pollution, *Legislation, Navigable waters, *Rivers and Harbors Act, Channel, Wastes, Lake Michigan.
Identifiers: Oil pollution act, California Debris Commission Act, FWPC Act.

The United States has enacted more than a dozen statutes that deal piecemeal with water quality and pollution control. The primary purpose of the earliest statutes was to protect and promote the navigability of the waters of the United States. The Rivers and Harbors Act of 1899, which is perhaps the most important of the early federal pollution control laws, prohibits the creation of any obstruction in navigable waters of the United States unless such is authorized by Congress. It also prohibits changing the channel of any navigable water unless the work is authorized by the Corps of Army Engineers, and section 13 makes it unlawful to discharge refuse of any kind or description, other than that flowing from streets and sewers and passing therefrom in a liquid state, into any navigable water of the United States. Some federal statutes relate to specific waters. Others that are more limited in scope relate to specific kinds of refuse or wastes. The best known of these is the Oil Pollution Act of 1924. The public-health aspects of water pollution have been handled under the Public Health Service Act. (Watson-Fla)
W69-02419

INTERNATIONAL LAW, TREATIES, AND WATER QUALITY,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 243, pp 348-354, 1967. 7 p.

Descriptors: *Water quality, *International law, Federal government, International waters, *Treaties, Mexico, International commissions, Water pollution, Oil, Radioactive wastes, United Nations, *Mexican water treaty, Colorado River Basin, Colorado River.
Identifiers: Thermonuclear testing, Oil pollution act, Canada.

Pollution of the waters of the high seas, of inland waters of the United States, and of international drainage basins may be the subject of international law, including the provisions of multilateral and bilateral treaties entered into by the United States. International agreements have dealt with pollution of the high seas with oil, radioactive waste, and products of thermonuclear testing. Oil pollution from vessels is covered by the International Convention for the Prevention of the Pollution of the Sea by Oil, 1954. The United States is a party to the Convention and has implemented its provisions by the Oil Pollution Act of 1961. The United Nations Convention of the High Seas, to which the United States is a party, provides for the prevention of oil pollution and waste from radioactive substances and thermonuclear testing. Pollution problems with an international aspect may also result from pollution by foreign nations of inland waters of the United States. There is yet any multilateral convention or treaty relating to the pollution of waters of international basins, but the United States has individual treaties with both Canada and Mexico. (Watson-Fla)
W69-02420

INTERSTATE COMPACTS AND WATER QUALITY,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 242, pp 332-348, 1967. 17 p.

Descriptors: Water pollution, *Water quality, Administrative agencies, Standards, Effluents, Industrial wastes, Wastes, Pollutants, Legislation, Taxes, *Interstate compacts, *Interstate rivers, *River basin commissions, Colorado River, Delaware River Basin Commission.
Identifiers: SWPC Act.

Rights to permit or to prohibit degradation of water quality may be involved directly or indirectly in interstate compacts. An interstate compact may expressly disclaim any attempt to deal with water quality or pollution problems. States have agreed upon, and Congress has consented to, ten interstate compacts that deal directly with administrative controls for water quality and pollution. All of these compacts provide for an interstate commission or agency, with representatives from the states and in some cases also from the United States, to administer their provisions. The jurisdiction of an interstate commission is limited to waters in the interstate drainage basin with which the particular compact is concerned. Most of the compacts recognize expressly that no single standards of water quality could practicably be made applicable to all waters under the jurisdiction of their commissions. Most of the compacts provide that they are not intended to preclude any signatory state from imposing any additional conditions or restrictions to further lessen or prevent the pollution of waters within its jurisdiction. (Watson-Fla)
W69-02421

JUDICIAL REVIEW OF ACTIONS BY THE STATE WATER QUALITY AND POLLUTION CONTROL AGENCY,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 14, Sec 231, pp 273-293, 1967. 20 p.

Descriptors: Water pollution, *Water quality, Standards, *Administrative agencies, Effluents, Wastes, Pollutants, Legislation, *Judicial decisions, Remedies, Sewage, *Abatement.
Identifiers: Judicial review, SWPC Act, Injunction.

Effluent or receiving-water standards established by the agency may be challenged in judicial proceedings either because they are too strict or are not strict enough. Appeal from an administrative order may be inappropriate because the particular issues raised are not yet ripe for judicial review. Also, the plaintiff cannot secure judicial review of a determination until he has exhausted his administrative remedies. Any person aggrieved or adversely affected by administrative action has standing to seek judicial review. The agency seek injunctive relief against any person violating provisions of the act or an administrative order. In jurisdictions which provide for appeal from the agency's orders, collateral attack on an administrative determination is not permitted. The doctrine of primary jurisdiction does not relate to direct judicial review of administrative action. Administrative actions and water quality and pollution control statutes have been challenged on constitutional grounds. Almost uniformly, these constitutional challenges have failed. (Watson-Fla)
W69-02422

REMEDIES FOR ENFORCEMENT BY THE STATE WATER QUALITY AND POLLUTION CONTROL AGENCY,
Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 14, Sec 230, pp 267-273, 1967. 7 p.

Descriptors: *Water pollution, Water quality, *Standards, *Administrative agencies, Effluents, Wastes, Pollutants, Legislation, *Remedies, Sewage.
Identifiers: SWPC Act.

Public officials have the privilege of entering private property to avert an imminent public disaster, to abate a public nuisance, or to perform such other duty or exercise such other authority as may be imposed or created by statute. These privileges permit the summary abatement, without notice or hearing, of water pollution requiring immediate action, eg, where the pollution constitutes an immediate and direct threat to public health. Most alleged violations will be attacked by the board by way of an order after notice and hearing. In issuing such orders, the board can take into account not only the remedial action required but also the timing for such action in light of all the circumstances. In order to determine whether violations are taking place, or even to convince itself that they are not, the board should be authorized to require technical reports and to examine other records of any persons relating to water quality and pollution. State laws generally provide that violation of the statute regulations or orders is a misdemeanor. (Watson-Fla)
W69-02423

ADMINISTRATIVE POWERS OF THE STATE WATER QUALITY AND POLLUTION CONTROL AGENCY,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 14, Sec 229, pp 230-267, 1967. 37 p, 1 tab.

Descriptors: Water pollution, *Water quality, *Administrative agencies, *Standards, Effluents, Industrial wastes, Wastes, Pollutants, Legislation, *Taxes.
Identifiers: Receiving waters, SWPC Act.

The traditional approach to water quality and pollution control by a state administrative agency has been to specify the characteristics of the effluent being discharged into state waters or the conditions to be maintained in the receiving waters. Most commonly; some combination of the above methods is used. Establishment and implementation of these standards is usually on a case-by-case basis. Thus, the standards may vary from one body of water to another. In general, the system of classification designates the beneficial uses to be protected and the water quality required to provide such protection. Although the classification will consist primarily of receiving-water standards, it will often provide some effluent standards; it may also include the degree of treatment required for the waters, eg, removal of natural impurities. Financial incentives such as an income tax deduction or an exemption of water quality facilities from ad valorem property taxes are used in addition to technological advice. (Watson-Fla)
W69-02424

ORGANIZATION AND JURISDICTION OF THE STATE WATER QUALITY AND POLLUTION CONTROL AGENCY,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 14, sec 227-228, pp 205-230, 1967. 25p

Descriptors: *Water pollution, *Water quality wastes, Streams, Sewage, Legislation, *Administration, Administrative agencies.
Identifiers: SWPC Act.

Discarding old systems whereby authority was fragmented among many different agencies, most states have vested responsibility for pollution control and for over-all coordination and regulation of water quality in a state administrative board composed of representatives of the affected interests. Usually an Executive Secretary administers and enforces the board's decisions. A recent trend is to place the board in an agency with more than merely water quality and pollution control responsibilities--either a water resources agency or an agency which deals with a number of environmental quality problems, eg, air pollution. The jurisdiction of the water quality and pollution control agency should be broad, covering all the waters within the state and all persons whose activities may affect the quality of the waters of the state. (Watson-Fla)
W69-02425

WATER POLLUTION AS A PUBLIC OFFENSE,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 13, sec 220, pp 190-196, 1967. 7 p.

Descriptors: *Water pollution, Water rights, Reasonable use, Invasion, Riparian rights, Remedies, *Damages, Competing uses, *Legislation, Easements, Prescriptive rights, Legal aspects, Judicial decisions.
Identifiers: Injunction, Defenses.

Water pollution may constitute a public offense against the state, commonly called a public nuisance. Although it is punishable as a crime, a public nuisance can be attacked in civil proceedings by public authorities and by a private party if he can show that the pollution constitutes a private nuisance. A public nuisance may be caused by water pollution in three different ways: (1) it may affect a large number of persons; (2) it may affect a public resource; or (3) it may be unlawful by statute. If water pollution is made a criminal offense, such offense is usually denominated a misdemeanor and may be punishable by fine or imprisonment. Two civil remedies are also generally available against a public nuisance caused by water pollution. These are: (1) a suit in the name of the state to enjoin the pollution; and (2) a public official may enter upon the polluter's land to abate the public nuisance. Generally speaking, the defenses which may be asserted in actions against private nuisances are not valid in an action against a public nuisance. It is universally held that no prescriptive right can be obtained to maintain a public nuisance. (Watson-Fla)
W69-02426

INTERGOVERNMENTAL RELATIONSHIPS UNDER THE FWPC ACT,
Burton J. Gindler.
Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, sec 250, pp 408-410, 1967. 3 p.

Descriptors: Water quality, Water pllution, *Federal government, *Legislation, Administrative agencies, Abatement, Standards, *Jurisdiction, Oil, Canada, Rivers and Harbors Act, Mexican Water Treaty, *State governments.
Identifiers: FWPC Act, Public health service, Boundary waters treaty, Oil pollution act.

The FWPC Act contains a number of disclaimers. For example, it does not supplant other water quality and pollution control devices at other levels of government. State and interstate action is encouraged, and other federal remedies are preserved. Section 1 (c) declares the policy of the act to be nonimpairment of any right or jurisdiction of the states with respect to their waters, including boundary waters. Section 10 (b) provides that state and interstate action to abate pollution of interstate or navigable waters is encouraged and is not displaced by federal enforcement action, except as may be provided by court order. Section 14, dealing with federal laws, provides that the act shall not be construed to supercede or limit the functions of the Surgeon General, Public Health Service, or any other agency of the United States concerned with water pollution. (Watson-Fla)
W69-02427

BUMBARGER V WALKER (CONTAMINATION OF PERCOLATING WATERS).

193 Pa Super 301, 164 A 2d 144-151 (Super Ct Pa 1960).

Descriptors: *Judicial decisions, *Strip mine wastes, Domestic water, Taste, *Acid mine water, Fouling, Mine drainage, *Explosives, *Percolating water, Damages, Pennsylvania, Legal aspects.

Plaintiffs sought damages for the ruination of the quality of their spring water caused by sulfur-water intrusion from defendants' strip mining operations. The defendants' mine was on higher elevation than the spring, and the defendants engaged in heavy blasting and drilling in an effort to remove excess water from the mine. The jury found that this blasting could have altered the flow of subsurface waters, thereby rendering the water percolating into the spring unfit for domestic use. On appeal, the defendants contended that they could not be held liable for the damage to the spring, absent a showing of malice or negligence by the plaintiffs. The appellate court affirmed the jury's determination, saying that by damaging the plaintiffs' spring through their blasting operation, defendants were prima facie liable. The court determined that a mere showing that blasting was less expensive than pumping the excess water in a direction away from the spring offered no excuse for damaging another's property. The measure of damages, if permanent, was the difference in market value of the land before and after the injury, or the cost of removing the obstruction, whichever was lower. (Blunt-Fla)
W69-02450

UNITED STATES V REPUBLIC STEEL CORPORATION (INDUSTRIAL WASTES).
286 F 2d 875-891 (1961).

Descriptors: Rivers and Harbors Act, *Industrial wastes, Industrial water, Cooling water, Industrial plants, Dissolved solids, *Waste disposal, River beds, *Navigable rivers, *Channels, Federal government, Legislation, Judicial decisions, *Illinois.
Identifiers: Columet River, Flue dust.

The United States instituted suit to enjoin three iron and steel fabricators located along the Columet River from depositing industrial solids in a navigable river and asked that defendants be required to restore the depth of the channel. The suit was based on violation of sections 10 and 13 of the Rivers and Harbors Act. The United States District Court for the Northern District of Illinois found for the United States. The judgment was reversed by the appellate court but affirmed by the United States Supreme Court. On remand, the court affirmed the granting of the preliminary injunction by the Court of Appeals, finding, however, that there was no substantial evidence to support the factual determination of trial court that the 3 defendants were responsible for not less than 81 1/2% of the industrial solids found in the channel, and that there was no substantial evidence to support the finding regarding percentage of responsibility of the several defendants for such deposits. The case was remanded to the trial court for a new trial as to the demand of the United States that defendants restore the channel to its original depth of 21 feet. (Carruthers-Fla)
W69-02457

RIGHTS OF WAY FOR MINING, QUARRING, ETC.

83 Ga Code Ann sec 83-201--209 (1967).

Descriptors: *Georgia, Legislation, *Right-of-way, Rivers, Watercourses (Legal), *Mining, Mine water, Mine wastes, Withdrawal, *Consumptive use, Surplus water, Diversion, Diversion structures.

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Any person, corporation, or company which is actually engaged in mining and finds it necessary to obtain a right-of-way for any purpose over the lands of another in order to carry out such mining shall obtain such right-of-way in the manner prescribed for acquiring the right to convey water over the lands of another. Arbitrators may be selected where there is disagreement as to the necessity of the right-of-way or the compensation therefor. Arbitration is authorized to settle questions surrounding the diversion of watercourses. Upon payment of damages, the owner of any mine shall have the right to enter any land between it and the water source upon which the mine depends for the purpose of constructing ditches, flumes, or dams. The owner of such land is to be given notice. Only surplus water may be diverted entirely from streams. Procedures for the application for rights-of-way and the assessment of damages are set out. Lessees of mines are to be treated as owners under this act. (Williams-Fla)
W69-02459

AN ACT CONCERNING THE ELIMINATION OF POLLUTION OF THE WATERS OF THE STATE.
1967 Laws of Connecticut, Pub Act No 57, sec 1-6.

Descriptors: *Connecticut, *Legislation, Water pollution, *Water pollution control, Public health, Taxes, Water temperature, Sewage, Cities, Bodies of water, Pollution abatement, Federal government, Waste treatment, *Water quality control, Administrative agencies.
Identifiers: Fed Water Pollution Control Act, Connecticut Water Resources Comm.

The Connecticut legislature, in declaring pollution of state waters a public nuisance, inimical to public health, harmful to wildlife, and an impairment of agricultural, industrial, and other beneficial uses of such waters, has deemed the control and elimination of such pollution a public use and purpose for which public monies may be expended and tax exemptions granted. A Water Resources Commission was established to administer and enforce the Act. The terms of the act, including wastes, pollution, harmful thermal effect, and discharge were defined. Water was broadly construed to encompass tidal waters, harbors, drainage systems, and all accumulations of water, public or private, which are contained in, flow through, or border on the state. The commission has numerous specific powers, eg, the power to issue orders prohibiting pollution, the power to convene hearings and to subpoena witnesses and evidence, and the power to approve construction of pollution abatement facilities. It shall adopt water quality standards consistent with the Federal Water Pollution Control Act. However, public hearings must be conducted prior to the adoption or amendment of such standards. (Geraghty-Fla)
W69-02462

AN ACT CONCERNING THE ELIMINATION OF POLLUTION OF THE WATERS OF THE STATE.

1967 Laws of Connecticut, Pub Act No 57, sec 7-35.

Descriptors: *Connecticut, Legislation, Cities, *Permits, *Pollution abatement, Water pollution, Treatment facilities, Construction costs, Water quality, *Taxes, Local governments, Remedies.
Identifiers: FWPCA.

If the commission finds that any municipality is causing pollution of state waters, it shall issue an order to abate pollution. The order shall include a time table for action and a list of steps to be taken. Similar orders shall be issued to any person causing pollution of state waters. After the effective date of the act, no person shall create or originate any new discharge of water, substance, or material into the state's waters without a permit from the Commission. Sources of discharge operating under such permits shall be periodically investigated by the Commission. Any person or municipality failing to comply with a pollution abatement order shall be enjoined until such time as the order has been fully complied with. A knowing violation of the Act is subject to a fine as fixed by the court. The Commission shall make grants to any municipality for the construction or expansion of pollution abatement facilities in accordance with the provisions of the Act. Specific sections of the Act provide for tax credits or deductions to individuals for the construction or improvement of pollution abatement facilities. (Geraghty-Fla)
W69-02463

HOOD V SLEFKIN (SUIT TO ENJOIN DAM OWNER FROM CHANGING WATER LEVEL).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02465

CHEMICAL ASPECTS OF ACID MINE DRAINAGE,
Pennsylvania State Univ., University Park; and Michigan State Univ., East Lansing.
H. L. Barnes, and S. B. Romberger.
J Water Pollut Contr Federation, Vol 40, No 3, Part 1, pp 371-384, Mar 1968. 14 p, 5 fig, 1 tab, 15 ref.

Descriptors: *Acid mine water, *Mine drainage, *Coal mines, *Water pollution sources, *Hydrologic aspects, *Water pollution treatment, Bactericides, Neutralization, Carbonate rocks, Appalachian Mountain Region.
Identifiers: *Acid drainage prevention, Inorganic sources, Chemical environment.

Acid mine drainage is discussed in terms of the conditions of its formation, prevention of acid production, and treatment of acid waters. Environmental Eh and pH vary widely among places where oxidation of iron sulfides releases sulfuric acid in mine waters. At high Eh, direct reaction of sulfides with dissolved oxygen releases acid; at low Eh, no thermodynamically reasonable mechanism compatible with field observations has been found. In simple hydrologic situations, carbonation saturation of mine drainage water may prevent acid formation, but bactericides, air-sealing of mines, and passivation of mineral surfaces are unlikely to be effective. Culturing of sulfate-reducing bacteria might be beneficial for flooded mines. Treatment of acid drainage by finely ground carbonate-rich rocks is an economical method; dilution and buffering of acid by mixing with bicarbonate-rich waters is preferable. The principal problem in treatment is removal of ferric oxhydroxide hydrate from suspension. (Knapp-USGS)
W69-02518

CONTROL OF MINE DRAINAGE WATER,
Pennsylvania State Univ., University Park.
Harold L. Lovell, and E. Bruce Jones.
Proceedings of the Third Annual American Water Resources Conference 1967, pp 314-324, 11 p, 2 tab, 4 fig.

Descriptors: Mine wastes, Coal mine wastes, Mine drainage, Water pollution treatment, Water pollution control, Flash distillation, Neutralization, Sulfides, Iron compounds.
Identifiers: Pennsylvania State University, Solid-fluid separation.

Coal mine drainage creates a stream contamination problem which currently plagues several eastern states. It introduces iron, aluminum and sulfate ions as well as sulfuric acid into receiving streams and frequently produces unsightly sediments on stream bottoms. These constitute an environment which is generally incompatible with aquatic life, recreation use and industrial water requirements. Such pollution develops naturally under proper environmental conditions but it is enhanced by mining operations. Corrective approaches to these pollution conditions include prevention of its formation, amelioration, diversion to areas where the contamination might be less innocuous, and water treatment for the removal of the contaminants. At the present time, one of the approaches being taken by the Pennsylvania State University is the construction of a versatile experimental plant for treating such waters. (Seneca-Rutgers)
W69-02539

DIGITAL SIMULATION OF ESTUARINE WATER QUALITY,
National Center for Air Pollution Control, Durham, N. C.; and Agricultural Research Service, Fort Collins, Colo.
Richard B. Dornhelm, and David A. Woolhiser.
Water Resources Research, Vol 4, No 6, pp 1317-1328, December 1968. 12 p, 9 fig, 10 ref.

Descriptors: Water quality, Model studies, Management, Stability, Dispersion, Waste dumps, Estuaries.
Identifiers: *Digital simulation, *Estuarine water quality, Partial differential equations, Finite-difference scheme, Delaware Estuary.

Partial differential equations describing the unsteady, one-dimensional mixing process in an idealized homogeneous, linearly expanding estuary are presented and solved numerically, using an implicit finite-difference scheme. These solutions portray the change in concentration of conservative substances with time and distance as a result of tidal fluctuations and variable inflow. Although the model presented is highly simplified in terms of estuarine geometry, experiments with varying boundary conditions can provide insight into the adequacy of the more commonly used quasi steady-state models. (Seneca-Rutgers)
W69-02545

THE USE OF SIMULATION IN WATER RESEARCH.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02604

EVALUATION OF COLUMBIA RIVER COOLING PROGRAM,
Battelle Memorial Inst., Richland, Wash.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02607

SYSTEMS ANALYSIS FOR QUALITY MANAGEMENT,
Oregon State Univ., Corvallis; and Federal Water Pollution Control Administration, Portland, Oreg.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02608

SYSTEMS ANALYSIS: AN ECONOMIST'S VIEW,
Ohio State Univ., Columbus.
Richard A. Tybout.
Systems Approach to Water Quality in the Great Lakes, Proc 3rd Annu Symp Water Resources Res, pp 117-126, Ohio State Univ, Sept 1967. 10 p.

Descriptors: *Systems analysis, *Economics, *Water pollution control, *Standards, Public benefits, Public rights, Marginal utility, Marginal costs, Pricing, Constraints, Lake basins, Mathematical models, Lake Ontario, Lake Erie, Recreation demand, Cost-benefit analysis, Aesthetics, Water policy, Taxes, Optimization.

Three approaches to the problem of optimally attaining water quality standards in a hypothetical lake illustrated the interdependency of economics and systems analysis and the problem of philosophical approach in setting and administering of those standards. System I called for the solution of a simple linear model, where the costs

pollution removal for all users of a lake were equated to the costs of all pollution imposed on the lake by polluters. The quality standard for the lake was assumed given. System 2 maximized the utilities to all individuals from pollutant and non-pollutant generating products, subject to their budget constraints. System 3 maximized the benefit-cost ratios of various products, subject to budget constraints, assuming benefits and costs were quantifiable. The problems and merits of each approach and their combination were discussed. (Gysi-Cornell)
W69-02612

AN ECONOMIC APPROACH TO WATER QUALITY CONTROL,
Oregon State Univ., Corvallis.
Kenneth D. Kerri.
J Water Pollut Contr Fed, Vol 38, No 12, pp 1883-1897, Dec 1966. 15 p, 3 fig, 6 tab, 17 ref. See also W69-02615.

Descriptors: *Water quality control, Sewage effluents, *Sewage treatment, Biochemical oxygen demand, Digital computers, *Dissolved oxygen, *Economic efficiency, Estimated costs, Oxygen sag, Stream improvement, Water management (Applied), Waste storage, Municipal wastes, Pulp wastes.
Identifiers: Matrix, Willamette River (Oregon), Primary treatment, Secondary treatment.

An analytical model was developed which determined the degree of treatment required by each waste discharger along the Willamette River system in Oregon, in order to meet various effluent or system standards. A DO cost matrix contained the amount of oxygen-consuming wastes passing through a critical reach from each water discharger, the amount of waste removed by different degrees of treatment, and the cost of each degree of treatment for each discharger. The decision variable was the percent of waste removed at each point of discharge. The minimum cost solution was obtained from the matrix by nonlinear programming techniques, and this solution was inserted in the Streeter-Phelps oxygen sag equation to obtain the DO profile for the river. Several examples for various effluent and stream standards were computed and given. It was found that the cost of maintaining effluent standards was much higher than the cost of maintaining various stream standards. The model made possible the economic comparison of alternative management policies, and might justify larger stream sampling programs. (Gysi-Cornell)
W69-02614

A DYNAMIC MODEL FOR WATER QUALITY CONTROL,
Sacramento State College, Calif.
Kenneth D. Kerri.
J Water Pollut Contr Fed, Vol 39, No 5, pp 772-786, May 1967. 15 p, 3 fig, 3 tab, 14 ref.

Descriptors: *Water quality control, *Sewage treatment, Biochemical oxygen demand, Dissolved oxygen, Economic efficiency, Alternative costs, Average costs, *Benefit sharing, Comparative benefits, Marginal costs, Salvage value, *Administrative decisions, Legislation, Sewage districts, *Economies of scale.
Identifiers: Willamette River (Oregon), Association.

From the conclusion of an earlier paper (W69-02614) that the establishment of stream quality standards obtained by nonlinear programming techniques resulted in lower treatment costs than the enforcement of effluent standards, a presentation was made for the organization of river basin waste treatment associations. Cost curves showed that if all plants in the association were built as fixed output conventional plants, except for one pivotal plant which could be operated over a wide range, large economies could result. The pivotal plant would preferably have a low marginal treatment cost, a large discharge, and would be located just above the critical reach. The selection and size of the treatment facilities would be chosen by computer on the basis of the marginal and average cost curves of the plants. Capacity of the system would be sized on the 10- to 20-year low flow using real or simulated hydrologic data. The dynamic conditions of the association (expansion of municipalities and firms and changing standards) were discussed, and the results of numerical examples for new firms entering the association were tabled. (Gysi-Cornell)
W69-02615

STREAMFLOW REGULATION FOR ACID CONTROL,
Federal Water Pollution Control Administration, Washington, D. C.
G. K. Young, and L. F. Gitto.
Proc IBM Sci Computing Symp Water and Air Resources Manage, pp 317-330, Oct 1967. 14 p, 6 fig, 5 ref, 1 append.

Descriptors: *Acid streams, Data storage and retrieval, *Dynamic programming, *Regulated flow, *Regression analysis, *Reservoir operation, River flow, Least squares method, Statistical methods, Correlation analysis, Stream improvement, Water management (Applied), Water quality control, Fishkill.
Identifiers: *Loss functions, Kiskiminetas River Basin, Allegheny River, Cumulative density function.

Dynamic programming was used to derive and optimum operating rule for flood control reservoirs in the Kiskiminetas River Basin, in order to keep the highly acidic discharges into the Allegheny River as close as possible to 20% of the total 'Kiski' plus Allegheny flow, and at the same time keep the reservoirs as empty as possible. Various loss functions were used in a forward looking dynamic programming technique for the period July 1 to October 1, 1954. Storage was constrained to be zero on the first and last days, and a maximum of 5% of the system total. A loss function which allowed only 2 occurences at ratios above 0.4 in the frequency distribution plot was chosen. The loss function was then tested for all summers in the 1954-64 interval, the system optimized, and from a linear regression of a subset (every seventh day) of the data, a relation for discharge as a function of reservoir inflow and Allegheny flow was obtained. Significant improvement (lowering) of the flow ratios, as compared to the actual ratios, occurred when the daily flows for 1954-64 were routed through the reservoirs using the operating rule. (Gysi-Cornell)
W69-02618

WATERWAYS OBTAINED.

N C Gen Stat sec 74-25-31 (1964).

Descriptors: *North Carolina, Legislation, Legal aspects, *Mine drainage, Surface drainage, Ditches, Appraisals, *Damages, Obstruction to flow, *Mine wastes, Sediments, Runoff, Streams, Drains.

The procedures to be followed by one engaged in mining who finds it necessary to convey water over the lands of another are stated. A petition is to be made to the clerk of the superior court of the county in which the affected lands are situated. If the petition request is granted, the clerk appoints 3 appraisers to assess the damage. After the clerk has approved the report by the appraisers, petitioner has the right to make such drains, ditches or other necessary work, provided the damages assessed have been paid or tendered. This act makes it a misdemeanor to obstruct any drain or ditch constructed as authorized by this chapter. Waste, water, and sediment from mining and washing kaolin and mica are allowed to run off into the natural courses and streams. (Childs-Florida)
W69-02700

TAX EXEMPTION OF AIR AND WATER POLLUTION ABATEMENT FACILITIES.
N C Gen Stat sec 105-297 (16) (1967 Supp).

Descriptors: *North Carolina, Legislation, Legal aspects, Administrative agencies, Local governments, *Taxes, Sewage systems, *Treatment facilities, Air pollution, Water pollution, *Pollution abatement, Permits, Public utilities.
Identifiers: Board of water and air resources, Tax exemption.

Air cleaning devices, sewage and waste treatment facilities, and air or water pollution abatement equipment are exempted from taxation. The requirements for obtaining this exemption are stated in this act. (Childs-Florida)
W69-02704

CONTAMINATING WATER SUPPLIES.

La R S 14:58 (1965).

Descriptors: *Louisiana, Legislation, *Water pollution, Water supply, Legal aspects, *Public health, Domestic water.
Identifiers: *Penal statute.

This act prohibits the intentional performance of any act tending to contaminate any public or private water supply. When the act foreseeably endangers the life or health of human beings, the penalty is more severe. (Childs-Fla)
W69-02726

06. WATER RESOURCES PLANNING

6A. Techniques OF Planning

THE DEMAND FOR INLAND WATERWAY TRANSPORTATION,
Purdue Univ., Lafayette, Ind.
Eugene Silberberg.
Water Resources Research, Vol 2, No 1, pp 13-29, First Quarter 1966. 17 p, 16 tab, 8 ref.

Descriptors: *Transportation, *Inland waterways, *Coals, Rates, Demand, Supply, Forecasting, Mississippi River, Linear programming, Costs, Cost-benefit analysis, Tariff, Efficiencies.
Identifiers: Demand for transportation, Barge transportation, Trade pattern, Interregional coal flows, Freight rates, Aggregation.

A new type of forecasting model of great potential for predicting flows in complicated spatial transportation networks is illustrated through application to the forecasting of interregional coal flows by barge over the Mississippi River system. Changes in these flows are related to regional coal production and consumption levels and to the freight charges by barge and rail. The special feature of the model is the great saving on the data needed for its implementation made possible by assuming that transportation patterns will be efficient, i.e., least-cost, for given regional imports and exports. This assumption is incorporated by using the linear programming transportation method to generate individual flows from regional barge imports and exports forecasts by a system of statistically fitted equations. Various applications are illustrated. (Seneca-Rutgers)
W69-02535

MEAN RANGE OF LINEARLY DEPENDENT NORMAL VARIABLES WITH APPLICATION TO STORAGE PROBLEMS,
Colorado State Univ., Fort Collins.
Vujica Yevjevich.
Water Resources Research, Vol 3, No 3, pp 663-671, Third Quarter 1967. 9 p, 5 fig, 3 tab, 2 ref.

Descriptors: Markov processes, Average, Water storage, Monte Carlo method.

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Identifiers: *Mean range, *Normal variable, Autocorrelated, Linear dependence, Simple moving average. Autoregressive schemes.

The exact equations for the mean range of some normal but autocorrelated variables, of known population means and known linear dependence, are developed. The basic hypothesis was that the exact expression in the general form for the mean range of linearly dependent normal variables is the same as for the normal independent variable, which form was derived from the mean range given by Anis and Lloyd. The data generation method (with a large sample of 250,000 random numbers) was used to assess the differences in mean ranges between the developed equations and the computer results. For three cases, a first and second-order Markov linear dependence and the simple moving average scheme, the differences are very small, and they are of the order of magnitude of the sampling errors for the data generation method. The expressions for exact values of mean range are derived for: (1) the general Markov linear dependence model; (2) the first-order Markov linear dependence; (3) the general linear moving average scheme; and (4) the simple linear moving average scheme. (Seneca-Rutgers)
W69-02538

A NOTE ON THE AVERAGE PROBABILITY OF EXTREME EVENTS,
Geological Survey, Miami, Fla.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02548

PERCEPTION OF FLOOD HAZARD IN A SMALL NEW JERSEY TOWN,
Rutgers-The State Univ., New Brunswick, N. J.
For primary bibliographic entry see Field 06F.
For abstract, see .
W69-02554

A STOCHASTIC MODEL FOR OPERATING A MULTIPURPOSE RESERVOIR,
Federal Water Pollution Control Administration, Washington, D. C.; and Cornell Univ., Ithaca, N. Y.
Gary N. Dietrich, and Daniel P. Loucks.
Proc Ser No 3, Symp Amer Water Resour Ass, San Francisco, Calif, pp 92-104, Nov 1967. 13 p, 2 tab, 5 ref.

Descriptors: *Reservoir operation, Optimum use, Flood control, Inflow, Multiple purpose reservoirs, Water storage, Recreation, Streamflow, Fish and wildlife, Hydroelectric power, Drawdown, Reservoir storage, Models, Computer programming, Irrigation water, Mathematical analysis, Synthetic hydrology, Stochastic processes, Hydrology, Time.
Identifiers: *Operating criteria.

A stochastic linear programming method for defining optimal operating policies for a multipurpose reservoir is discussed. An operating policy refers to a schedule that specifies the amount of water to be released from the reservoir in any given time period and for any given condition of reservoir volume and previous inflow. An optimal policy prescribes those releases that satisfy operating objectives. The linear programming model considers time periods, transition probabilities, constraints, objective functions, and alternative objectives in developing equations for reservoir operation. A 2-part problem illustrates the model developed. The first part involves determining an optimal operating policy for a reservoir serving the functions of hydroelectric power production, irrigation water supply, streamflow maintenance, recreation on the reservoir, and flood control. The second part involves determining the operating policy for the same reservoir with streamflow maintenance deleted from the requirements. Results of the calculations are included. (USBR)
W69-02590

UNBALANCED BIDDING MODELS--THEORY,
Delaware Univ., Newark.
Robert M. Stark.
Proc Amer Soc Civ Eng, J Constr Div, Vol 94, No CO2, pp 197-209, Oct 1968. 13 p, 3 tab, 6 ref, 5 append.

Descriptors: Contracting, Models, Construction costs, *Contracts, *Bids, Mathematical analysis, *Linear programming, Mathematical models, Administration, Economies, Theory, Costs, Computation, Analysis, Cost analysis, Contract administration, Digital computers, Investment, Unit costs, Profit.

A class of unbalanced bidding problems appropriate for unit price proposals is identified. Using the present worth of future revenue as an objective, several models are constructed for optimal unbalancing of a bid. A linear programming formulation emerges in a natural way. The implications of unbalanced bidding to the bidder and sponsor are considered. An advantage of the models is their demand for more thorough proposal and bid preparation. The lowest bid does not necessarily mean the lowest cost of the project. Another feature of the models is that they permit either or both parties, through constraints, to exercise any control they deem desirable. It is easy to compare the gain from an unbalanced bid, using the models developed in the paper. Models with a simple numerical example are illustrated. (USBR)
W69-02602

THE USE OF SIMULATION IN WATER RESEARCH.
SEMINAR WR 006.67, Oregon State Univ. Corvallis, Jan 1967. 122 p, 26 fig, 3 tab, 41 ref.

Descriptors: *Simulation analysis, Computer models, *Research and development, River basin development, River regulation, Stream improvement, *Water resources, Water quality control, Planning, Flood damage, Digital computers, Analog computers, Thermodynamic behavior, Decision making.
Identifiers: Willamette River, Columbia River, Oregon State University.

Eight papers and one abstract described presentations given at an Oregon State University seminar on simulation in the fall of 1966. The 'History and Significance of Simulation Models,' a comparison of 'Digital vs Analog Models,' the 'Biological Considerations in Water Management,' the interaction of 'Simulation and Public Decision Making,' and the 'Advantages and Dangers of Simulation' were all discussed. The economic effect of a change in a reservoir decision rule on downstream flood damages was illustrated in a paper on 'Analytic Simulation'. A simulation model, used to predict river temperature downstream of several reservoirs dependent on inflow, and air temperatures, discharge, wind velocity, sky cover, reservoir size, etc, was presented in a paper on 'Evaluation of Columbia River Cooling Program'. A predictive water quality model for the Willamette River, which used the 'STORET' storage and retrieval program, was presented in 'Systems Analysis for Quality Management'. (Gysi-Cornell)
W69-02604

ANALYTICAL SIMULATION,
Oregon State Univ., Corvallis.
Dale D. McFarlane.
Use of Simulation in Water Research, SEMINAR WR 006.67, pp 17-29, Oregon State Univ, Jan 1967. 13 p, 2 fig, 2 tab.

Descriptors: *Simulation analysis, Water resources development planning, *Flood control, Flood damage, Flood forecasting, Decision making, *Reservoir operation, Analytical techniques, Comparative costs, Design flood, Hydrologic data, Risks, River regulation.
Identifiers: Reservoir decision rules, Predicted flows.

The purposes and methodology of analytical simulation were introduced, and an application of its use was illustrated by a flood control model. General applications of simulation to water resources planning and development were discussed and diagrammed. A specific application of the comparison of decision rules for controlling a hypothetical reservoir's outflow was given. The objective was to determine the decision rule which minimized downstream flood damage. Decision rule 1 called for the release of the maximum amount of water in any period, without exceeding the flood stage outflow, if possible. Decision rule 2 called for the same release, unless the predicted 6 month average future inflow exceeded the flood stage flow, in which case the 6 month predicted average was released. Results for the two rules were tabled. Decision rule 2 dominated decision rule 1 for the assumed (exponential) damage function used. (Gysi-Cornell)
W69-02605

DIGITAL VS ANALOG MODELS,
Oregon State Univ., Corvallis.
Lovis N. Stone.
In Use of Simulation in Water Research, SEMINAR WR 006.67, pp 31-41. Oregon State Univ, Jan 1967. 11 p.

Descriptors: *Analog computers, *Digital computers, *Simulation analysis, Analytical techniques, Water resources development, Analog models, *Comparative costs, Computer models, Economic efficiency.
Identifiers: *Hybrid computers, Digital differential analyzer, Dynamic simulation, Oregon State University.

A comparison of present and future use of digital and analog computers for simulation, including digital differential analyzers and hybrid computers was given. The basis for discrete whole number operation of the digital computer using a memory and arithmetic unit was compared to the continuous operation of the analog computer which uses high gain amplifiers. The digital differential or incremental digital computer, and the hybrid computer which is a union of the analog and digital computers were discussed. Advantages and limitations of each type were presented. Examples of the speed and cost saving abilities of computers for simulation were given. Present and future capabilities for computer simulation in the United States, and Oregon State University in particular, were outlined. (Gysi-Cornell)
W69-02606

EVALUATION OF COLUMBIA RIVER COOLING PROGRAM,
Battelle Memorial Inst., Richland, Wash.
Robert T. Jaske.
In Use of Simulation in Water Research, SEMINAR WR 006.67, pp 43-71, Oregon State Univ, Jan 1967. 29 p, 11 fig, 13 ref.

Descriptors: Digital computers, *Simulation analysis, Thermal water, *Heat budget, Cooling water, *Reservoir operation, *River regulation, *Temperature control, Flow control, Meteorological data, Mixing stream improvement, Water management (Applied).
Identifiers: Columbia River, Grand Coulee Dam, Hanford Project.

A simulation model used to predict river temperatures downstream of a series of reservoirs was presented and the results of three years programmed releases from Grand Coulee Dam to reduce river temperatures at the Hanford project were reported. The simulation program named COL HEAT was based on a 1962 head budget study. Basic assumptions of the model, such as discretization of cross-sectional flow, averaging of inputs, and use of single point data sources were evaluated. Since the program required iterative computational techniques a digital computer was used. The program was verified using historical data. Parametric studies indicated that Grand Coulee release temperatures contributed the major effect

to river temperatures for downstream. The effects of low and high tube, and spillway programmed releases to effect downstream temperatures were reported. (Gysi-Cornell)
W69-02607

SYSTEMS ANALYSIS FOR QUALITY MANAGEMENT,
Oregon State Univ., Corvallis; and Federal Water Pollution Control Administration, Portland, Oreg.
Fred J. Burgess, and J. Larry Worley.
In Use of Simulation in Water Research, SEMINAR WR 006.67, pp 85-109, Oregon State Univ, Jan 1967. 25 p, 12 fig, 11 ref.

Descriptors: *Systems analysis, *Water quality control, Water management (Applied), *Data storage and retrieval, River regulation, *Flow augmentation, Gaging stations, Dissolved oxygen, Oxygen requirements, River basins, Temperature, Waste treatment, Stream improvement, Optimization, Reservoir operation.
Identifiers: Willamette River, Oregon.

A computer study was used to find the optimum flow augmentation scheme necessary to meet minimum dissolved oxygen standards in a river system. The system of analysis is described and shown schematically on a simplified logic diagram. It involved starting at the upstream reach, and iteratively incrementing flow augmentation where possible to meet minimum DO requirements. The model used modified forms of the Streeter-Phelps equations. Results of some parametric studies of the Willamette River in Oregon were discussed and shown in figures. The effect of water temperature on augmentation requirements was discussed. A data storage and retrieval system (called STORET), which is a national system devised for efficient computer handling of streamflow data was described. (Gysi-Cornell)
W69-02608

SYSTEM DESIGN BY OPERATIONS RESEARCH.
Illinois Univ., Urbana.

In Chow, V T Handbook of Applied Hydrology, New York, McGraw-Hill, 1964. pp 26-47, 2 fig, 66 ref.

Descriptors: *Operations research, Optimum development plans, Design criteria, Economic efficiency, Marginal benefits, Marginal costs, Flood control, Simulation analysis, Linear programming, Dynamic programming, Statistical models.

A short review of operations research techniques and their applications to the design of water resources was presented. Some design criteria and economic concepts associated with public water resources development were given. The two techniques presented wee simulation and mathematical programming. Under simulation, the author discussed briefly sampling techniques, operating procedures, and sequential generation of hydrologic data. Under the mathematical programming section, both general deterministic and stochastic linear and dynamic programming models were structured and discussed. (Gablinger-Cornell)
W69-02609

OPTIMUM IRRIGATED PRACTICE UNDER CONDITIONS OF DEFICIENT WATER SUPPLY,
California Univ., Los Angeles.
Warren A. Hall, and Nathan Buras.
Amer Soc of Agr Eng, Trans, Vol 4, Gen Edition No 1, pp 131-134, 1961. 4 p, 4 fig, 2 ref.

Descriptors: *Dynamic programming, *Irrigation efficiency, Water shortage, Return (Monetary), Optimization, Net profit, Homogeneity, Mathematical models.

Dynamic programming was used to determine the optimum (maximum return) irrigation practices under conditions of deficient water supply. The problem was structured for a multi-unit irrigation form, assuming the expected value of the net economic benefit was known and identical for all crops. A special case of irrigation of homogeneous lands was structured and solved by a simple graphical procedure based on the dynamic programming technique. The postulate of identical return functions implied that a single crop or very similar crops were to be grown, otherwise the land to be devoted to different crops might be considered as a separate problem. (Gablinger-Cornell)
W69-02610

SYSTEMS ANALYSIS: AN ECONOMIST'S VIEW,
Ohio State Univ., Columbus.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02612

ECOLOGICAL SYSTEMS ANALYSIS AND WATER QUALITY,
Oak Ridge National Lab., Tenn.
For primary bibliographic entry see Field 05C.
For abstract, see .
W69-02613

AN ECONOMIC APPROACH TO WATER QUALITY CONTROL,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02614

A DYNAMIC MODEL FOR WATER QUALITY CONTROL,
Sacramento State College, Calif.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02615

THE INFLUENCE OF UNCERTAINTY IN STREAMFLOW ON FIRM POWER COMMITMENT IN HYDROELECTRIC POWER SYSTEMS,
Stanford Univ., Calif.
Oswaldo Alberto Armitano-Matheus.
Rep CCS-7, Inst In Eng-Econ Syst, Stanford Univ, Dec 1965. 43 p, 7 fig, 3 tab, 4 ref, 3 append.

Descriptors: *Hydroelectric power, Stochastic processes, Streamflow, Synthetic hydrology, *Scheduling, Simulation analysis, Statistical methods, Reservoir storage, Probability, Economic efficiency, Mathematical models, Digital computers, Benefits, Electric power demand.
Identifiers: Nonlinear programming, *Gradient projection method, Firm power commitment.

Nonlinear programming techniques (gradient projection methods) were used to obtain firm and secondary power commitments for a hydroelectric company, under the uncertainty of streamflow. The objective was to maximize the expected net profit, assuming power demands were known with one degree of freedom, and system generating capacities were given. To overcome the high dimensionality of the stochastic streamflows, a model of the system was used to obtain a new random variable, the maximum hydroelectric power available per historical year. Two methods were developed to obtain the new variable: one for a single-dam case used an iterative simulation technique, the other for a multi-dam case used the gradient projection technique. The probability density function inferred from the values of maximum power available per year was used to obtain the power commitments that maximized expected profits. Hypothetical one- and two-dam examples were appended. (Gysi-Cornell)
W69-02616

STREAMFLOW REGULATION FOR ACID CONTROL,
Federal Water Pollution Control Administration, Washington, D. C.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02618

THE OPTIMUM USE OF A GROUND-WATER AND SURFACE-WATER SYSTEM: A PARAMETRIC LINEAR PROGRAMMING APPROACH,
California Univ., Berkeley.
John A. Dracup.
Tech Rep 6-24, Water Resources Center, Contrib No 107, Hydraul Lab, Univ of Calif, Berkeley, July 1966. 134 pp, 17 fig, 23 tab, 55 ref.

Descriptors: *Conjunctive use, *Linear programming, Surface-ground water relationships, Artificial recharge, Water distribution (Applied), Water demand, *Water resources development, Reclaimed water, Decision making, *Optimization, Economic efficiency, Irrigation water, Municiple water.
Identifiers: Sensitivity analysis, *Parametric analysis, San Gabriel Valley, California, Imported water.

A parametric linear programming model was used to find the optimal ground-water and surface-water allocation for a 30-year period in the San Gabriel Valley of California. The parametric analysis included variation of objective function cost coefficients and the requirements vector of the constraint set. Unit costs were determined by economic analysis. Five sources of water (local surface water, imported water from 2 sources, ground water, and reclaimed waste water) were utilized optimally to satisfy three water requirements (municipal and industrial, agricultural, and artificial recharge). Three possible decision rules were analyzed to determine optimum operating procedures. A sensitivity analysis on the cost coefficients, and the significance of the imputed prices, was included. It was concluded that the method was effective as a guide for long range optimum decision making for water resource systems. (Gysi-Cornell)
W69-02619

REVITALIZING A FERTILE PLAIN,
Harvard Univ., Cambridge, Mass.
Myron B. Fiering.
Water Resources Res, Vol 1, No 1, pp 41-61, Jan-Mar 1965. 21 p, 20 fig, 4 tab, 1 chart, 5 ref, 1 append.

Descriptors: Aquifers, *Computer programs, Correlation analysis, Seasonal, *Simulation analysis, Economic efficiency, Hydrologic data, Irrigation design, *Optimum development plans, Drawdown, Deep-well pumping, *Drainage wells, Well spacing, *Water table, Salinity.
Identifiers: Indus River (West Pakistan).

The application of systems analysis and digital computer simulation to the control of waterlogging and salinity in West Pakistan was described. A single well field model was structured, the exogenous, endogenous, state and decision variables were defined and the computer program presented. The model was constructed with four seasons per year, using stochastic hydrologic input data. Assumptions in the computation, operating policy, and results of the program were discussed. A multiwell model was also structured. Example results were displayed in figures and tables indicating the most efficient rate and pattern of well spacing. (Gysi-Cornell)
W69-02620

DESIGN OF OPTIMAL HYDRAULIC NETWORKS,
Boeing Co., Renton, Wash.
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-02621

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DYNAMIC PROGRAMMING METHODS APPLIED TO WATERSHED MANAGEMENT PROBLEMS,
California Univ., Los Angeles.
Nathan Buras.
Amer Soc of Agr Eng, Trans, Vol 5, Gen Edition No 1, pp 3-5, 1962. 3 p, 12 ref.

Descriptors: *Dynamic programming, Mathematical models, Watershed management, Runoff, Forage grasses, *Brush control, Staistical models, Discount rate.

Dynamic programming was used to determine the conversion of the vegative cover of a watershed from brush to grass. By this conversion, a dual benefit may be realized: (1) the range is improved and (2) more water becomes available for runoff. The problem was structured for both deterministic and probabilistic growth conditions. Discounting and solution procedures for linear and non-linear return functions were discussed. (Gablinger-Cornell)
W69-02622

PROJECT YIELDS BY A PROBABILITY METHOD,
Colorado River Board of California, Los Angeles.
W. Don Maughan, and R. Y. Kawano.
Amer Soc Civil Eng Proc, Vol 89, No HY3, pp 41-60, May 1963. 20 p, 10 fig, 6 tab, 9 ref.

Descriptors: Design flow, Digital computers, Economic efficiency, Frequency analysis, Hydrologic data, *Streamflow forecasting, *Reservoir design, Reservoir operation, *Probability, Project planning, Risks, *Statistical methods, Sampling, *Synthetic hydrology.
Identifiers: Deviation, *Safe yield, Firm draft, *Confidence limits.

A statistical computation method for estimating safe yield from a proposed reservoir was presented, and applied to an illustrative example for the Glen Canyon Reservoir. It was assumed that fairly long streamflow records existed, that the flows were semirandom events, the reservoir had some designated volume at the beginning of the study period, and that the reservoir could be operated hypothetically to obtain the safe yield. 66 years of record were used to semirandomly create 100 sets of 50-year synthetic streamflow data. A digital computer program performed the statistical computations and plotted graphs of cumulative departures from the mean for each sequence. Manual graphical analyses of the results gave the safe yield for each sequence. Statistical analyses of the 100 safe yields resulted in the establishment of confidence limits for the annual safe yield, depending on the initial state of the reservoir. Mass analyses could be carried out for various sized reservoirs, resulting in different safe yields for a chosen degree of risk. An economic analysis would then be used to determine the optimum reservoir size. (Gysi-Cornell)
W69-02623

WATER RESOURCE CONSTRAINTS ON A REGIONAL ECONOMY,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
David L. Raphael.
American Water Resources Association, Proceedings, Third Annual American Water Resources Conf., San Francisco, 1967, pp 617-629. 12 p, 1 fig, 3 tab, 5 ref.

Descriptors: *Operations research, Analytical techniques, Methodology, Regional analysis, Model studies, Mathematical models, *Leontief models, Structural models, Estimating, Theoretical analysis, Water supply, Demand.
Identifiers: Clinton County (Pennsylvania).

The report is an attempt to adapt a class or mathematical models, used elsewhere, to the field of Water Resources Studies. The models are of the Leontief input-output model type and have a successful history of application. They fall into the body of knowledge generally subsumed under the headings Operations Research or Management Science. Presented is an attempt to make use of a complex and quantitative methodology in a new area of application. The specific goal of the paper is to discuss the development of meaningful water resource constraints for a regional economy. The general water supply-demand mode is discussed, with specific application to Clinton County, Pennsylvania. A pilot version of a water supply-demand model for Clinton County has been completed. It consists of two interconnected linear flow, input-output models. These are: (1) an economic money flow model simulating the economy of the county, and (2) a water flow model simulating the water supply demand relationships operating within the county region. The programming problems are discussed and the mathematical development of the models presented. (Gargola-Chicago)
W69-02790

6B. Evaluation Process

WATER BASED RECREATION IN NEVADA: TAHOE,
Nevada Univ., Reno. Div. of Agricultural Economics and Education.
George A. Myles.
Max C. Fleischman - College of Agriculture, University of Nevada, pub. No. B-10, pp 1-22, Nov. 1966. 28 p, 1 map, 3 photo, 7 tab, 2 ref.

Descriptors: *Recreation demand, *Personal surveys, Age, Education, Average income, Investment, Weather data.
Identifiers: Economics, *Nevada, *Recreation.

During the summer of 1965, a personal interview type of survey was conducted at Lake Tahoe, Nevada. The purpose of the study was to acquire information concerning the use of water based recreational areas; desire for or satisfaction with facilities and services; the using public's willingness to pay for use of areas and facilities; the expenditures of visitors; and characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities, and services. Opinions and recommendations for the improvement of the existing facilities were obtained from the visitors. The information acquired is useful in estimating the market potential from site visitors and in planning future developments. (Grossman-Rutgers)
W69-02401

WATER BASED RECREATION IN NEVADA: WESTERN DESERT AND NORTHERN LAKES,
Nevada Univ., Reno. Div. of Agricultural Economics and Education.
George A. Myles.
Max C. Fleischman - College of Agriculture, University of Nevada, Pub No. B 14, pp 1-74, March 1967. 84 p, 3 map, 8 photo, 22 tab, 7 charts, 3 append, 4 ref.

Descriptors: *Recreation demand, *Personal surveys, Age. Education, Average income, Investment, Weather data.
Identifiers: Economics, *Nevada, *Recreation.

A survey of all visitors to Pyramid Lake, Lahontan Reservoir, Topaz Lake, Walker Lake, Rye Patch Reservoir, Wildhorse Reservoir, and other northeast water recreation areas in Nevada was conducted during the summer of 1965. The purpose of the survey was to acquire information concerning the use of water based recreational areas; desire for or satisfaction with facilities and services; the using public's willingness to pay for use of areas and facilities; the expenditures of visitors; and characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities, and services. In addition to information about the characteristics of the visitors, their recommendations were obtained. Photographs, maps, and data are included in the report. (Grossman-Rutgers)
W69-02402

WATER BASED RECREATION IN NEVADA, MEAD AND MOHAVE,
Nevada Univ., Reno. Agricultural Experiment Station.
George A. Myles.
Max C. Fleischman College of Agriculture, Report B-13, pp 1-24, Dec 1966. 28 p, 6 photo, 7 tab, 2 ref, 1 append.

Descriptors: *Recreation demand, *Surveys, *Costs, Education, Average income, Occupations.
Identifiers: Economics, *Nevada, *Recreation.

The survey method was used to determine information concerning recreational areas, desire for or satisfaction with facilities and services, the using public's willingness to pay for use of areas and facilities, the expenditures of visitors, and characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities and services. Visitors made some suggestions for improvement in respect to providing shade or greenery, clean beaches, removing rocks and improving surfaces, and enlarging camp grounds. Most visitors participated in relaxation and swimming. Other activities of visitors included camping, sightseeing, and photography. The average daily expenses of those interviewed were $18.29. (Grossman-Rutgers)
W69-02403

CONCEPTUAL PROBLEMS IN WATER QUALITY ECONOMICS,
California State Water Resources Control Board, Sacramento.
Virgil Whitely, and Bill B. Dendy.
Journal of the Sanitary Engineering Division, Am. Soc. Civ. Engr., pp 841-848, Oct 1968. 8 p.

Descriptors: *Water pollution control, Water quality act, *Water quality control, *Economic efficiency, Economic benefits, Economic justification, *Economic feasibility, Benefit cost analysis, Aesthetics, Public health recreation.

An economist and an engineer on the staff of the California State Water Resources Control Board consider water-quality economics, as a result of responsibilities placed upon their agency in connection with the San Francisco Bay-Delta Water-Quality program. The authors are concerned by statements of the Federal Water Pollution Control Administration implying that the pollution control program should proceed regardless of economics. It is pointed out that if economic efficiency is to be a criterion for water quality projects, it is necessary to determine justification for water quality of a given level. The authors consider that water quality benefits, other than physical effects such as reducing water treatment costs, can be classified under the headings of recreational improvement, public health and aesthetics. Recreational values can be evaluated, but as yet there is no consensus as to the best approach. The category of aesthetic effects is obviously considered in a rather broad sense, since the suggested evaluation approach is through land values. The authors consider that tangible values evaluated by such means may not be enough to justify a project in themselves; but they are a useful indicator, to be supplemented by consideration of intangibles. (Whipple-Rutgers)
W69-02404

MEASUREMENT OF THE IMPACT OF RECREATION INVESTMENTS ON A LOCAL ECONOMY,
Wisconsin Univ., Madison; and Cornell Univ., N. Y.
Robert J. Kalter, and William B. Lord.
Amer Jour of Agric Econ, Vol 50, No 2, pp 243-245, May 1968. 14 p, 2 tab, 21 ref.

Descriptors: *Input-output analysis, *Recreation, *Public benefit, Income, Investment, Direct benefits, Indirect benefits, Employment, Wisconsin, Regional analysis.
Identifiers: From-to analysis, Interindustry model, Sales multiplier.

A from-to type of interindustry model is formulated and empirically implemented to quantify local economic impacts of a transfer nature arising from outdoor recreation. Direct, indirect, and induced sales, income, and employment impacts are derived and multiplier values are calculated. Relationships among the from-to model, supplemental studies, and the analysis of regional benefits for governmental investment decisions are discussed. The multiplier values permit comparisons to be made of the impact of demand changes on the regional economy, and through the use of income multiplier values, provide a means of determining the benefits of various activities on the regional economy. The from-to model provides an operationally feasible method for determining the regional benefits resulting from governmental activities and for analysing regional economies.
W69-02410

THE MARKET FOR WATER BASED OUTDOOR RECREATION SERVICES IN NEW CASTLE COUNTY, DELAWARE,
Delaware Univ., Newark. Dept. of Economics.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-02470

CITY OF WILMINGTON WATER SYSTEM,
Delaware Univ., Newark. Urban Affairs Div.
Francis X. Tannian.
Research Project Partial Technical Completion Report to Office of Water Resources Department of the Interior, Washington, D. C., November 1, 1968. 3 p. OWRR Project A-003-Del.

Descriptors: *Wilmington Water System, History, Legal basis, Organization and staffing, *Physical inputs, *Physical outputs, Costs, Revenues, Excess capacity, *Cost-benefit analysis.

This study examines the history of the Wilmington Water Department, its legal basis, organization and staffing, physical inputs and operating inputs, output and its allocation, costs, revenues and pricing. The department serves customers outside the city limits, and residents of unincorporated areas of the county. Its service area is not clearly defined by law or practice, and this should be clarified to facilitate planning. Improvements in organization and staffing are required. Physical inputs--source, land, storage system, purification facilities, pumping stations, and distribution system--are described with particular attention to age and capacity, and then related to physical output. The system has excess capacity which will gradually diminish but not be eliminated until about the year 2000. Output is purchased by residential and nonresidential customers in the city and the country; county rates are twice the city rates, with certain exceptions. The rate structure produces an effective price per 1,000 gallons that varies inversely with meter size and consumption, and this favors large volume users. As a result, revenues from residential users are proportionately greater than their consumption, while revenues from nonresidential users are proportionately less. Insofar as proportionate usage reflects cost of service, the former users subsidize the latter. A comparison of effective price per 1,000 gallons for each meter size with average cost per 1,000 gallons also suggests a subsidy to large volume users. The subsidies produced by the present pricing system (block rate structure) can be eliminated or minimized by several alternative pricing arrangements which better equate revenue collected from users with the cost of serving them. The excess capacity of the water system could be used to earn revenue by selling water to neighboring systems.
W69-02471

ECONOMIC AND ENGINEERING FEASIBILITY OF A UNIFIED WATER SYSTEM FOR NORTHERN NEW CASTLE COUNTRY, DELAWARE,
Delaware Univ., Newark. Urban Affairs Div.
Marvin R. Brams.
Research Project Partial Technical Completion Report to Office of Water Resources Research, Department of the Interior, Washington, D. C., November 1, 1968. 4 p. OWRR Project A-003-Del.

Descriptors: *Unified water system, *Economic feasibility, *Engineering feasibility, *Input-output analysis, *Cost-benefit analysis, Costs of unification, Benefit of unification, Physical unification, Administrative unification, Efficiency, Equity.

Northern New Castle County, Delaware is served by 12 independent water systems, 7 are private companies and 5 are municipal. Each is important to the area it serves, but all are not of equal importance when viewed as components of a County system. Interconnections allow intersystem transfers of water, but not all systems are interconnected. An engineering consultant examined the physical aspect of unifying supply and distribution systems and concluded that (1) there are a number of short-term opportunities for intersystem transfer not now being utilized, but these opportunities would vanish in the long run because the eventual demands on each system would require all of its present resources, (2) wholesale unification of distribution systems was not feasible, but there are several areas where it looks promising and important benefits could result. The limits of physical unification do not preclude complete administrative unification. If the water systems were unified, partially or wholly, physically and administratively, under County ownership, many benefits would result. The many pricing policies of the independent systems could be replaced with fewer policies, perhaps only one. This would facilitate the control of water resources, and more equitably allocate cost to various user groups. Operating economies would result from economies of scale, and duplication of facilities would be avoided. Source of supply would be more efficiently distributed, and this could postpone or eliminate the need for additional facilities. Water would be of a higher and more uniform quality, and fire protection would be much improved. A framework conducive to comprehensive, county-wide planning for water resources would be created. The benefits of unification justify a range of purchase prices, of which many would be reasonable compensation. Partial unification could begin by purchasing the private systems, and this may prove a suitable compromise between no unification and complete unification in the event that municipal systems remain independent of, but cooperative with, the County system. The County would, no doubt, survive without partial or full unification, but water would be supplied and distributed less efficiently and at greater cost.
W69-02472

THE NATION'S WATER RESOURCES SUMMARY REPORT.
Water Resources Council, Washington, D. C.

U S Water Resources Counc, pp 1-1--1-32, 1968. 32 p, 21 fig, 2 tab.

Descriptors: *Water resources, *United States, *Surveys, Water requirements, Water utilization, Water Resources Planning Act, Federal government, Planning, Water policy.
Identifiers: Water Resources Council.

A summary report of the first National Water Resources Assessment describes the water and related land resources of the Nation, and presents the findings and recommendations of the Water Resources Council. The present and projected future uses of water and present and recommended management of water with its related land are described and recommendations are made. Water supplies and requirements are described for 20 regions in the U. S. (Knapp-USGS)
W69-02498

THE RELATION OF WATER RESOURCES TO THE INDUSTRIAL AND RECREATIONAL POTENTIAL OF THE MISSISSIPPI GULF COAST,
Mississippi State Univ., State College. Bureau of Business and Economic Research.
A. A. Armenakis, R. F. Pearson, and W. P. Neely.

Miss State Univ Water Resources Res Inst, 228 p, 1968. 6 fig, 8 map, 44 tab, 128 ref, 2 append.

Descriptors: *Water resources, *Recreation, *Industries, *Water resources development, *Mississippi, Groundwater, Surface waters, Water demand, Water management (Applied), Social aspects, Human population, Average income.
Identifiers: Mississippi Gulf Coast.

Information from published water-resource reports and from questionnaires and interviews with water users in the Mississippi Gulf Coast Counties is compiled and analyzed in a study of the relation of water resources to industrial and recreational potential of the area. The major conclusions reached are that water is plentiful and of good quality for most uses, but the quality must be maintained if both industry and recreation are to increase to their potentially much greater role in the area. Waterborne transportation was an important factor in the choice of location of 62% of the area's industries. Improvements of channels and terminal facilities are part of the development plans of the area. Hancock, Harrison, and Jackson Counties have detailed water development plans of which reviews are included. (Knapp-USGS)
W69-02499

RECREATIONAL CONSIDERATIONS IN THE CALIFORNIA WATER PLAN,
California State Dept. of Water Resources.
M. J. Shelton.
In Proceedings-Conference on Recreational Use of Impounded Water, issued by Committee on Research in Water Resources, University of California, pp 27-34, December 1956. 8 p, disc.

Descriptors: Water requirements, Impounded waters, Distribution, Spawning, *Multiple-purpose projects, *California, *Recreation.
Identifiers: *California Water Plan, Economic growth, Water development.

Outdoor recreation in California is big business. It is estimated that the state's 1.9 million hunting and fishing license holders spend more than a quarter of a billion dollars annually in pursuit of their favorite sport. There are thousands of small impoundments in California, many of which are open to fishing, swimming, camping and other recreation activities. The physical effect of this projected water development in terms of available water is an increase in the number of major lakes in California by about 260 and the total surface acreage by many thousands. It is believed that public accessibility to recreational streams and lakes will be increased many fold. Many of the proposed reservoirs will block the spawning grounds of migratory fish, but even these unavoidable losses can be mitigated. In some instances, new reservoirs represent the only water playgrounds in large areas formerly having none at all. Water and outdoor recreation cannot be separated. That is why planning for both aspects of water development should be considered at the same time. (Seneca-Rutgers)
W69-02526

THE ECONOMICS OF URBAN DRAINAGE,
Virginia Military Inst., Lexington, Va.
John W. Knapp.
Proceedings of the Third Annual American Water Resources Conference, 1967, pp 631-640, 10 p, 2 fig, 4 tab, 6 ref.

Descriptors: *Drainage systems, Urbanization, *Costs, Benefits, Planning, Investment, Physical properties, Design, Regression analysis.
Identifiers: Prediction models.

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Urbanization in the United States will require at least a billion dollar per year investment in new drainage facilities. Thus there is a need for planning aids to consider alternative designs. Examination of over 100 small urban drainage systems reveals that investment in convention systems depends upon design factors and characteristics of the drainage area. Physical properties, including geographic features of the basin and hydrologic characteristics, are the most significant cost components; however, design factors are also important. Regression techniques are used to explain differences in design methods and to develop prediction equations for cost studies of various levels of design. (Seneca-Rutgers)
W69-02527

PRESERVATION VALUES IN RIVER BASIN PLANNING,
Izaak Walton League of America.
For primary bibliographic entry see Field 06D.
For abstract, see .
W69-02529

COMPARING ATTITUDES TOWARD WATER POLLUTION IN SYRACUSE,
Syracuse Univ., N. Y. Maxwell Graduate School of Citizenship and Public Affairs.
H. George Frederickson, and Howard Magnas.
Water Resources Research, Vol 4, No 5, pp 877-889, Oct 1968. 13 p, 1 fig, 6 tab, 8 ref.

Descriptors: Water pollution control, Sewage sludge, Waste water, Sewage treatment.
Identifiers: Public good, Onondaga County, Syracuse, Individual benefits, Public opinion, *Social aspects, *Political aspects.

A random sample survey of the attitudes of residents in Onondaga County, Syracuse, New York, toward water pollution and other local problems indicated the following: Water pollution is regarded as a middle-level public priority, coming after education and law enforcement in the view of suburban residents and after education, law enforcement, housing, and employment in the view of city residents. Traffic, road maintenance, parks and recreation, and welfare were regarded by both city and suburban residents as lower-order public priorities. The respondents felt directly affected by water pollution and associated it with various types of recreation. They regarded industry as a greater contributor to pollution than public jurisdictions and held local governments responsible for improving water quality. Respondents varied widely in their willingness to be taxed to abate pollution. Those with higher socioeconomic status were more willing to pay for pollution abatement than those with lower socioeconomic status. (Seneca-Rutgers)
W69-02533

THE HUMAN FACTOR AND CHANGES IN WATER USAGE PATTERNS,
Utah State Univ., Logan.
H. Bruce Bylund.
Water Resources Research, Vol 2, No 3, pp 365-369, Third Quarter 1966. 5 p, 8 ref.

Descriptors: Social aspects, Water resource development, *Social change, Psychological aspects, Attitudes, Social adjustment, Motivation, Utah.
Identifiers: Bear River Project, *Bureau of Reclamation, Rationality, Vested interests.

Many obstacles to the more efficient use of water resources are human rather than physical. Human obstacles are as real as physical ones and they must be dealt with if effective changes are to result. In the preliminary work on the Bear River Project two types of opposition were clearly demonstrated: general opposition to change at a covert emotional level and a more reasoned opposition by individuals and groups with a vested interest. Those individuals and groups with vested interests used several tactics to sway public opinion. In some ways opposition to proposed projects is functional. It can help to shape optimal development of water resources and to take into account as nearly as possible the rights and wishes of the local people. It can also act as a needed counterbalance to governmental bureaucracies. When opposition occurs from bungling through inept interpersonal relations or from lies and half-truths of individuals or groups with vested interests, it is no longer functional. This dysfunctional opposition is costly in terms of both time and money. (Seneca-Rutgers)
W69-02540

REGIONAL PLANNING FOR WATER DEVELOPMENT, THE PACIFIC NORTHWEST,
Pacific Northwest River Basins Commission, Vancouver, Wash.
Charles W. Hodde.
Proceedings of the Third Annual American Water Resources Conference, 1967, pp 36-43, 8 p.

Descriptors: *Pacific Northwest U. S., Geographical regions, Idaho, Oregon, Washington, Water Resources Planning Act, *River Basin Commissions, Water resources, Planning, *Water resources development, Governments, Federal government, Wyoming, Montana, Southwest U. S., Columbia River, Water utilization.
Identifiers: *Pacific Northwest River Basin Commission, Columbia-North Pacific Comprehensive Study.

In this article Charles Hodde, Chairman of the Pacific Northwest River Basin Commission, describes his organization and explains his concept of water resources planning for the region. The Pacific Northwest River Basin Commission was established by Executive Order under the provisions of the Water Resources Planning Act of 1965. The Commission has members representing the states of Idaho, Montana, Oregon, Washington and Wyoming in addition to representatives from several federal departments. There may be an addition of one or two members representing interstate compacts approved by Congress if such compact organizations desire representation. The Commission is charged with the responsibility of developing a long-range comprehensive plan for the preservation, development and best use of its water and related lands. The Commission is not designed to take over the planning of future water projects. Instead it is a coordinating mechanism chiefly interested in a proper relationship of the planning of all entities-federal, state, local and private. The threat of substantial diversion of water from the Columbia River system to the Southwest is a cohesive force within the Commission. According to Mr. Hodde, the Pacific Northwest has uses for all its water. (Seneca-Rutgers)
W69-02543

PLANNING FOR GROUND WATER BASIN MANAGEMENT,
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-02544

WISCONSIN'S SHORELAND AND FLOOD PLAIN PROTECTION PROGRAM,
Wisconsin Bureau of State Planning, Madison.
For primary bibliographic entry see Field 06F.
For abstract, see .
W69-02550

BENEFIT-COST ANALYSIS AND EXTERNALITIES IN PRIVATE CHOICE: COMMENT,
Michigan State Univ., East Lansing.
Robert A. Solo.
Southern Econ Jour, Vol XXXIV, No 4, pp 569-570, April 1968. 2 p.

Descriptors: *Cost-benefit analysis, Alternative costs.
Identifiers: *Consumer surplus, Entrepreneurial choice, *Externalities, Private activity.

There are both external economies and external diseconomies left out ot account by the entrepreneur and both consequent upon entrepreneurial choice. There is not a priori reason to suppose that the economies overbalance the diseconomies or vice versa. Where a proposed project is intended to replace a specific activity in the private sector, e.g. a publicly-owned nuclear reactor for a coal-based generating capacity in private hands, it is just as feasible that the benefit-cost analysis take into account the sacrificed external benefits of the private activity as that it take into account the anticipated benefits of the public project. The public authority is no more likely to take into account the distant and diffused benefits and costs consequent upon the project to which that analysis relates, than it is to take account of the distant and diffused externalities of the activities which it replaces. It, therefore, cannot be assumed that there is a systematic bias built into benefit-cost analysis favoring the public vis-a-vis the private activity. (Seneca-Rutgers)
W69-02551

THE PROCESS OF MAKING GOOD DECISIONS ABOUT THE USE OF THE ENVIRONMENT OF MAN,
Calgary Univ. (Alberta).
Louis Hamill.
Natural Resources Journal, Vol 8, No 2, pp 279-301, April 1968. 23 p, 1 tab.

Descriptors: *Decision making, *Methodology, Environment, Forecasting, *Economics, *Operations research, Efficiencies, Date collections.
Identifiers: Assumptions, Management science, Alternatives, Criteria, Objectives, Programmed decisions, Non-programmed decisions.

There are major objections to the use of economic theory as a basis for making decisions about the use of resources or environments: (1) There is no substantial agreement about which theory is to be used. (2) Economic theory requires all aspects of the problem to be quantifiable. (3) The assumptions are seldom realistic. (4) The results of the theory tend to persist after their usefulness has ended. (5) Economic theory requires a substantial amount of time and evergy to master. Rather than using economic theory, decision makers should use the principles of operations research and management science. Unlike economics, operations research and management science are not primarily interested in developing a body of knowledge; they are far more interested in developing sets of procedures that will produce efficient action. Efficient decision making requires the conscious and explicit consideration of each element of the decision process in an orderly way. The decision process usually is begun by the recognition of a problem. Once the problem is recognized, the alternative courses of action can be identified and the consequences of each action can be forecasted. The next step is to explicitly state the objectives of the decision maker. (Seneca-Rutgers)
W69-02552

ECONOMIC PLANNING FOR STAGED DEVELOPMENT,
Harza Engineering Co., Chicago, Ill.
Kenneth E. Sorensen, and Robert D. Jackson.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY5, pp 1231-1244, Sept 1968. 14p, 9 fig, 2 ref, append.

Descriptors: *Planning, Project planning, Economics, Investigations, *River basin development, Resource development, Optimum use, Benefits, Optimum development plans, Cost comparisons, Policy matters, Costs, Water costs, Benefit-cost ratios, Water resources, Project feasibility, *Projects, Capital costs, Investment, Obsolescence, Economic feasibility.
Identifiers: *Staged development.

The economic merits of water projects vary with the opportunities for multistage development. The following factors involving engineering techniques and economic criteria should be considered when planning and evaluating staged developments: (1) investment capital is limited; (2) investment is justified only if beneficial use is achieved within a reasonable time; (3) essential needs must be met by the most economic alternative (in the absence of overriding considerations); and (4) investment in desirable but unessential projects must bring a return commensurate with other investment opportunities. Each of these factors is discussed. So that the water resources planner may realistically evaluate the economic merits of water projects, various reasons for staged development, types thereof, economic factors, and contemporary analytic procedures are presented with examples of known applicaton. (USBR)
W69-02586

ECONOMIC DERIVATION OF RESERVOIR OPERATING RULES,
Kentucky Univ., Lexington.
L. Douglas James.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY5, pp 1217-1230, Sept 1968. 14 p, 4 fig, 7 tab, 10 ref, append.

Descriptors: *Reservoir operation, Operations, Flood control, Water storage, Multiple purpose reservoirs, Recreation, Water supplies, Economics, Optimum use, Benefits, Policy matters, Simulation, Planning, Streamflow, Streamflow records, Drawdown, Water resources, Water laws, Reservoir storage, Torts.
Identifiers: Rough River Reservoir (Ky), *Operating criteria.

Reservoir operation requires rules to indicate the amount of water that should be held on a month by month basis throughout the year. In a system of reservoirs, operating rules must also allocate purpose-storage space for each reservoir. While extensive research has been reported on designing water resource systems for increased economic efficiency, applying economic criteria to the derivation of rules for reservoir operation has received limited attention. Proper design and operation are equally prerequisite to efficient resource utilization. Economic tradeoffs may be used to resolve conflicting storage requirements of flood control, recreation, and water supply in accordance with time changes in demand. Total potential purpose benefits and economic loss functions are determined to derive operating rules for the case study of Rough River Reservoir, Ky. Legal and other practical problems in implementing such rules are described. (USBR)
W69-02587

LINEAR DYNAMIC DECOMPOSITION PROGRAMMING OF OPTIMAL LONG RANGE OPERATION OF A MULTIPLE MULTI-PURPOSE RESERVOIR SYSTEM,
California Univ., Berkeley.
Shailendra C. Parikh.
Rep, Oper Res Center, ORC 66-28, Univ of Calif, Berkeley, Sept 1966. 25 p, 7 fig, 4 tab, 5 ref.

Descriptors: *Linear programming, *Dynamic programming, *Reservoir operation, Reservoir storage, *Long-term planning, *Multiple-purpose reservoirs, Optimization, Monthly, Mathematical models, Digital computers, Constraints, Decision making, Electric power demand, Water demand.
Identifiers: Decomposition principal, North California.

The decomposition principle of linear programming was used together with dynamic programming to obtain optimum long range releases and firm power and water commitments, for two actual reservoir systems in Northern California. The mathematical model, using deterministic inflows, combined the dynamic programming approach applied to a single reservoir with the decomposition principle of linear programs to interconnect all the reservoirs. Physical constraints (e.g., maximum and minimum reservoir and generating capacities) were established for 2 reservoir-24 month and 4 reservoir-36 month models, from Northern California reservoir data and 1926-28 hydrology. The constraint set was proved to be not convex, but the effect of the nonconvexity was found to be not significant. The program was written for the IBM 7094. Computer times and results were tabled. It was found that optimal values of firm water and firm energy were reached after relatively few iterations of the program. (Gysi-Cornell)
W69-02617

WHAT HAPPENED TO MULTIPLE PURPOSE RESOURCE DEVELOPMENT. -- A PLEA FOR REASONABLENESS,
Wyoming Univ., Laramie, Coll. of Law.
Raphael J. Moses.
Land and Water L Rev, Vol 3, No 1, pp 435-441, 1968. 7 p, 22 ref.

Descriptors: *Multiple-purpose projects, *Water resources development, Recreation, *Conservation, Reservoirs, Dams, Impoundments, Land management, Project purposes, *Preservation, Legal aspects.

The author criticizes the result reached in several recent cases which reject multiple-purpose projects in the name of conservation and protection of scenic areas. These projects, which provide widespread recreational facilities, are another kind of conservation and should be looked upon reasonably in comparison with mere preservation of natural conditions. Several recent cases are discussed, and note is made of the fact that the police power has been held to authorize legislative measures aimed at preserving natural beauty. The argument that asthetic considerations should receive at least as much stress as large scale resource development is receiving widespread acceptance. There must be a balance struck between these two objectives of resource development. The wood industry is discussed as an example of resource development coupled with conservation techniques. A possible initial step in finding the answer to the perplexing value question of whether to develop or preserve is the establishment of a large group or agency to focus upon and delineate the issues. At any rate, a balance should be maintained between these two alternatives -- development and preservation. (Williams-Florida)
W69-02696

THE SOCIOLOGIC AND ECONOMIC ASPECTS OF WATER RESOURCES AND WATER RESOURCES PLANNING IN GEORGIA,
Georgia State Planning Bureau, Atlanta.
Ronald M. North, and Stephen J. Brannen.
Georgia Univ. Dept. of Agr. Eco., College of Agr., Inst. of Community and Area Devel, Special Report. University of Ga., pp 1-50, May 30, 1968, 3 maps, 2 fig, 11 ref.

Descriptors: *Social aspects, *Planning, *Resource development, *Census, *History, Inland waterways.

In the first section, the sociological aspects of Georgia, both in the past and present, are discussed. Both the present water transportation facilities and the current population densities by county are presented with maps. The next section examines in detail the appropriate planning process for Georgia. A basic overall plan and objectives are listed. The third section discusses the objectives and strategies of the Georgia water resources plan. The appropriate process of inventorying for water resources development in Georgia is the topic of the fourth section. The fifth section lists which resources should be inventoried. The last section states strategies for water resources planning. A summary and bibliography are also included. (Grossman-Rutgers)
W69-02774

ECONOMIC BASE STUDIES IN RESOURCE ADMINISTRATION,
Paul W. Barkley, and Thaine H. Allison, Jr.
Land Economics, Vol 44, No 4, pp 470-479, Nov 1968. 10 p, 20 ref.

Descriptors: *Water resources development, *Governments, *Project planning.
Identifiers: *Economics, *Base studies, *Resource administration.

Originally, the economic base study was used as a means of ascertaining growth potential and growth patterns for municipal areas. In the development of natural resources, the economic base study has been called upon to perform functions for which it is not well suited. The interest of Federal natural resource developing agencies have broadened to include the impact of whole sets of projects on various sectors of the economy. Base studies have presented discussions of the results of growth or have estimated the likely results of potential growth but have not come to grips with the essential questions of the causes of growth. The development of approaches that will determine the cause of growth needed. Three reports by Federal water resource developing agencies are examined and their short-comings are discussed. Further, some recommendations regarding the use of basic or comprehensive studies in natural resource planning are made. (Grossman-Rutgers)
W69-02775

ON THE TREATMENT OF INCOMMENSURABLES IN COST-BENEFIT ANALYSIS,
Wisconsin Univ., Madison. Dept. of Economics.
John E. Brandl.
Land Economics, Vol 44, No 4, pp 523-525, Nov 1968, 3 p, 1 fig, 2 ref.

Descriptors: Recreation, Water re-use, *Mathematical studies.
Identifiers: Economics, *Cost-benefit theory, *Incommensurables.

Incommensurable goods are those goods for which no common measure of value, such as dollars, exist. Cost-benefit analysis can be defined as the maximization of an objective function relating outputs of programs, subject to the production function or cost-effectiveness constraints to inputs subject to a limited budget. The transformation curve between recreational water reclamation is examined to shed light on the theory of cost-benefit analysis. The mathematical and logical argument for utilizing incommensurables are included. (Grossman-Rutgers)
W69-02776

AN ANALYSIS OF RECREATIONAL USE OF THE TVA LAKES,
Joseph J. Seneca, Paul Davidson, and Gerard F. Adams.
Land Economics, Vol 44, No 4, pp 529-534, Nov 1968. 6 p, 1 fig, 5 ref.

Descriptors: *Time series analysis, *Water supply, *Recreation demand.
Identifiers: Economics, *Mathematical studies.

The development and utilization of recreation facilities over time are examined. The Tennessee Valley Authority Lakes serve as the source of data for this study. The analysis is separated into two parts, a theoretical section and an aggregate time series study. The theoretical section examines the difference between the structural demand and supply equations and the reduced form. The empirical section shows that the changes in the area of recreational water available have a greater effect on water-oriented recreational activity than changes in the supply of ancillary facilities. (Grossman-Rutgers)
W69-02777

LIBRARY U. OF I. URBANA-CHAMPAIGN

ESTHETIC AND RECREATIONAL POTENTIAL OF SMALL NATURALISTIC STREAMS NEAR URBAN AREAS,
Kentucky Univ., Lexington. Water Resources Inst.
John A. Dearinger.
Water Resources Institute, University of Kentucky, Research Report No. 13, 1968. 260 p, 34 illus, 38 tab, 2 appen, 82 ref. OWRR Project A-010-Ky.

Descriptors: *Methodology, Evaluation, *Terrain analysis, Land use, Project planning, *Outdoor recreation, Aesthetic, Pyschological aspects, Social values, Attitudes, Behavior, Social aspects, Scenery, Aerial photography, Water quality, Wildlife, Recreation demand.
Identifiers: Boone Creek, Jessamine Creek, Kentucky, Potential.

The purpose of the study is to develop a method of evaluating the esthetic and recreational potential of small streams and their watersheds. The proposed method emphasizes the use of all available sources of information about the stream and its watershed, and is based on the principles of terrain analysis and land use planning, quantitative geomorphology, airphoto interpretation, the philosophy and psychology of value judgments and the economics of land use and outdoor recreation. Boon and Jessamine Creeks are the test cases in using the proposed method. The methodology contains two phases: (1) the inventory phase, and (2) analysis and evaluation phase. Scenic and recreational factors are enumerated and attempts made to evaluate them. Conclusions are: (1) esthetic and recreational values can be identified, inventoried, and used to evaluate a watersheds development potential, (2) methodology was fairly accurate; and (3) case studies revealed that many small stream areas possess considerable potential for many forms of esthetic enjoyment. (Gargola-Chicago)
W69-02780

WATER MANAGEMENT IN CENTRAL AND SOUTHERN FLORIDA,
Central and Southern Florida Flood Control District.
For primary bibliographic entry see Field 06F.
For abstract, see .
W69-02800

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ROSBOROUGH V CITY OF MOLINE (WATER DISTRIBUTION APPLIED).

30 Ill App 2d 167, 174 NE 2d 16-24 (1961).

Descriptors: *Illinois, Cities, *Legislation, Water law, Water rates, Utilities, Water users, Water costs, *Local governments, Legal aspects, *Public utilities, Water works, Water distribution (Applied), Facilities, Pipes, Distribution systems, Water supply, Judicial decisions, Conduits, Domestic water.

The issue in this case is whether, under the relevant Ill statutes, the cost of repair and replacement of a water service pipe running from a water main in the city street to the abutting property of the plaintiff is chargeable to plaintiff or to the defendant City of Moline. Under the relevant statutes the defendant had the power 'to make all needed rules and regulations.' The rules are a part of the contract with the plaintiff, and every consumer, and under such rules all service pipes and fixtures must be installed, maintained, and repaired at the expense of the property owners. The regular water rates of the defendant do not anticipate or include a charge for the installation or repair of service pipes from the main to the curb. The court held the rules in question to be reasonable, just and fair. They do not appear to be oppressive, contrary to law, or contrary to any public policy expressed by the legislature. (Smith-Fla)
W69-02443

FINANCING THE RECREATIONAL USE OF IMPOUNDED WATER,
California State Dept. of Natural Resources.
J. Delbert Sarber, and Elmer C. Aldrich.
Proceedings-Conference on Recreational Use of Impounded Water, issued by Committee on Research in Water Resources, University of California, pp 50-58, December 1956. 9 p, disc.

Descriptors: California, *Financing, *Impounded waters, Reservoirs, *Recreation facilities, Capital costs, Management, Administration.
Identifiers: *Public agencies.

Ownership, operation, purpose of the impounded water, nature of reservoir operation, and the extent of the recreational area which may be acquired, can be seen to give some indication of the size of the financing problem. An added cost factor is found in the amount of planning and programming activity which must precede the establishment of a reservoir recreation facility. Currently being discussed is the question of which agency ought properly to undertake the development of recreational areas at which level. Public pressure at the present time, logically or not, is probably the only instrument which will at least determine which agency or agencies will undertake the task of financing a recreational facility on a reservoir at a given location. Water recreation facilities are more costly initially than others though they lend themselves later to fee charges. A part of the initial cost of a project is that of 'developing' the land for public use. Normally, such developments will be carried forward by stages and the financing load will not be felt all at once. (Seneca-Rutgers)
W69-02525

THE NEW BULK SUPPLY TARIFF FOR ELECTRICITY,
Leicester Univ. (England).
Ronald L. Meek.
Econ Jour, Vol LXXVIII, No 309, pp 43-66, March 1968. 24 p, 4 fig, 1 tab, 1 chart.

Descriptors: *Electric power rates, Technology, *Peaking capacities, Welfare.
Identifiers: *Base capacities, Area Boards, Rate differentiation, *Bulk supply tariff, *Boiteux-Steiner model, Capacity cost.

The Central Electricity Generating Board recently announced details of a new Bulk Supply Tariff for electricity supplied to Area Boards. The appearance of this tariff is an event of some significance in the history of public authority pricing in the U.K., since both the running charges and the capacity charges are henceforth to be based on 'marginal principles'. The present paper deals first with the concrete details of the new reform, considering them within the context of a brief history of the tariff from nationalization to the present time. It then presents a theoretical structure (based on a development of the traditional Boiteux-Steiner peak-load pricing model) in terms of which the general validity of the new tariff may be assessed. It is concluded that the tariff, whether it can be said actually to involve 'marginal cost pricing' or not, will at any rate tend to achieve the general aim which would be - the maximisation of the sum of producers' and consumers' surpluses, subject to the constraint that total system costs are covered. The limitations of this analysis, as well as the 'equitability' of the new tariff and its possible effects on the retail tariffs charged by the Area Boards, are briefly discussed. (Seneca-Rutgers)
W69-02531

ASYMMETRY BETWEEN BRIBES AND CHARGES,
Carnegie Inst. of Tech., Pittsburgh, Pa.
For primary bibliographic entry see Field 05B.
For abstract, see .
W69-02534

ANALYSIS OF THE CONSTANCY OF THE EFFECTIVE TAX RATE,
Brookings Institution, Washington, D. C.
Terence J. Wales.
Rev Econ and Stat, Vol XLX, No 1, pp 103-110, Feb 1968. 8 p, 2 tab, 1 append.

Descriptors: Tax rate, Taxes, Progressive taxes.
Identifiers: *Effective tax rate, *Constancy, Taxable income, Taxable income growth, Marginal tax rate, Adjusted gross income.

The ratio of taxes to taxable income on individual returns remained approximately constant at 23.4 percent from 1955 to 1962, while taxable income increased more than 50 percent. Since the income tax structure is progressive, constancy of the effective tax rate seems at first glance to be a strange result. It is the purpose of this paper to show that such constancy is, in fact, not surprising. Even with proportional taxable income growth (across individuals) equivalent to nonproportional growth in recent years effective tax rate changes are not large. Further, there are good reasons for expecting taxable income growth to be nonproportional. First, proportional growth of adjusted gross income is a more realistic assumption than proportional growth of taxable income. Second, the annual distribution of new taxpayers probably differs from the distribution of existing taxpayers. Third, the growth in deductions and exemptions differs for various income levels. All three of these factors cause taxable income growth to be greater at low than high income levels, thus enhancing the importance of low marginal tax rates. This tends to moderate or prevent the increase in the effective rate that would result from the movement of returns to higher brackets. (Seneca-Rutgers)
W69-02546

AN EMPIRICAL DETERMINATION OF A DYNAMIC UTILITY FUNCTION,
Harvard Univ., Cambridge, Mass.
Koichi Mera.
Rev Econ and Stat, Vol XLX, No 1, pp 117-122, Feb 1968. 6 p, 3 fig, 3 tab, 6 ref.

Descriptors: Marginal utility, Growth rates, Discount rate, United States, National income, Capital, Regression analysis.
Identifiers: *Dynamic utility function, Elasticity of marginal utility, Personal consumption, Optimal growth, Japan, Canada.

An intertemporal optimization condition follows from any model of optimal growth. Such an equation usually contains two parameters which cannot be directly observed: the discount rate of future utility and the elasticity of marginal utility. These two parameters can be empirically estimated if they remain constant over time and if the assumed criterion function is maximized in the real economic system. In this paper a method of estimating these two parameters is presented and it is applied to the United States, Japan, and Canada. Although the results are not conclusive, in view of the assumptions involved, they tend to confirm the hypothesis that they are fairly stable over time, at least during a sociologically well-defined short period. (Seneca-Rutgers)
W69-02547

A NOTE ON THE ASYMMETRY BETWEEN FEES AND PAYMENTS,
Johns Hopkins Univ., Baltimore, Md.
David F. Bramhall, and Edwin S. Mills.
Water Resources Research, Vol 3, No 3, p 615-6, Third Quarter 1966. 2 p, 2 ref.

Descriptors: *Payment, *Pollution abatement, Waste disposal, *Administration.
Identifiers: *Fees, Effluent payments.

In his book The Economics of Regional Water Quality Management, Kneese compares the use of fees and payments to induce the abatement of waste discharges to bodies of water. The choice is between a fee that depends upon the amount of waste discharged and a payment that depends upon the amount by which waste discharges are less than they would otherwise have been. Kneese states that

the payment plan has many administrative difficulties (such as the determination of what discharges would have been in the absence of a payment scheme). However, Kneese concludes that in theory the choice between fees and payments is one of equity and not efficiency. In this article Bramhall and Mills question Kneese's conclusion. They contend that under the payment scheme profit will be larger than they would have been in the absence of intervention and under a fee scheme profits will be smaller than they would have been in the absence of intervention in the long run. On the usual assumptions about entry and exit, entry will take place in the former case and exit in the latter. Entry will lower the price of this product relative to other products and exit will raise it. Thus, in the long run relative prices will be different under a payment scheme than under the charge scheme. (Seneca-Rutgers)
W69-02553

UNBALANCED BIDDING MODELS--THEORY,
Delaware Univ., Newark.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02602

WATER WELL CONTRACTOR'S LICENSE ACT.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-02633

WOODSIDE HOMES, INC V TOWN OF MORRISTOWN (COSTS OF EXTENSION OF WATER MAINS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02718

6D. Water Demand

THE MARKET FOR WATER BASED OUTDOOR RECREATION SERVICES IN NEW CASTLE COUNTY, DELAWARE,
Delaware Univ., Newark. Dept. of Economics.
Paul Seidenstat.
Research Project Partial Technical Completion Report to Office of Water Resources Research, Department of the Interior, Washington, D. C., November 1, 1968. 3 p. OWRR Project A-003-Del.

Descriptors: *Water-based outdoor recreation, Water quality, *Demand, *Supply, Cost structure, Short-run costs, Long-run costs, *Projections, Shortages.

The demand for water-related recreation in an outdoor setting and the available supply are analyzed for the purpose of providing more precise information in a well-defined framework to facilitate decisionmaking. The framework is useful for decisionmaking at the local level elsewhere, as well as New Castle County. A definition of the demand for, and supply of, such recreational activities is developed with the aid of economic theory. Briefly, quantities demanded and supplied are taken as a function of price, but there are parameters such as population, family income, age-sex pattern, race and place of residence which determine the level of demand. Economic theory regarding the short-run and long-run behavior of costs is used to show that (1) underutilization or overutilization of a given sized facility can raise unit cost, (2) increasing size and capacity can reduce unit cost but (3) after a certain size is reached, it may be cheaper to develop another facility instead of expanding the capacity of the existing one. When demand for, and the supply of, such recreational facilities is measured, the supply in New Castle County at the present level of prices appears deficient. Substantial travel between the county and contingent recreation areas, the failure to meet certain national recreation standards and the obvious pressure on county facilities also support the conclusion. Furthermore, demand projections indicate an increasingly severe shortage in the absence of major expenditures. The advisability of making them involves assessing the innumerable benefits to consumers.
W69-02470

PRESERVATION VALUES IN RIVER BASIN PLANNING,
Izaak Walton League of America.
Roger Tippy.
Natural Resources Journal, Vol 8, No 2, pp 259-278, April 1968. 20 p, 2 tab.

Descriptors: *Planning, *River basin development, Decision making, *Preservation, Political aspects, Federal government, *Administrative agencies, Oregon, Judicial decisions, Permits, Wild rivers, Legislation, Missouri River, Montana.
Identifiers: *Army Corps of Engineers, *Federal Power Commission, Department of the Interior, Bureau of Reclamation, Rogue River Basin.

There are conflicts between development-conservationists and preservation-conservationists. These conflicts will increase because while an appreciation of the preservation values is rising, the demand for the benefits of water resource development is rising just as rapidly. Planning should illuminate all the values involved so that decisions to develop are made after consideration of the preservation values which will be lost, and so that decisions to preserve are made with an awareness of the development values foregone. Ideally, a river basin should have some areas suitable for preservation goals and other regions suitable for development goals. A competent planning unit could identify each of these areas and enable the decision makers to satisfy every interest group in the basin. In practice planning often seems to generate conflicts rather than resolve them. For such conflicts, two forms of resolution are available. Either the planners can present the decision makers a choice of alternatives or the planners can compromise the several values and present the decision-makers with a single answer which hopefully does not dissatisfy one interest group more than the others. (Seneca-Rutgers)
W69-02529

THE DEMAND FOR INLAND WATERWAY TRANSPORTATION,
Purdue Univ., Lafayette, Ind.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02535

SOME CONCEPTUAL PROBLEMS OF INTERPRETING THE VALUE OF WATER IN HUMID REGIONS,
Johns Hopkins Univ., Baltimore, Md.
Sherry Hessler Olson.
Water Resources Research, Vol 2, No 1, pp 1-11, First Quarter 1966. 11 p, 7 fig, 20 ref.

Descriptors: *Water values, *Humid areas, Water utilization, Return, Irrigation systems, Water costs, Productivity, Geographical regions, Recirculated water, Water distribution, Industrial water.
Identifiers: *Marginal value, *Depleting uses, *Nondepleting uses, Bethlehem Steel Company, Marginal revenue, Enler's theorem.

Procedures for calculating returns per acre-foot of water were developed in western United States irrigation projects and have been applied to supplemental irrigation in the humid eastern areas. These procedures constitute an operational definition of a marginal product of water, but the definition rests on a different theoretical basis in the two cases and does not apply to intermediate conditions. No general notion of marginal revenue of water appears meaningful for manufacturing uses, which are largely nondepleting. Comparisons made between the value of water in farming and in industrial uses are of doubtful value, particularly if they are extended to the humid regions. A method is proposed for estimating the 'marginal value' of water intake in manufacturing. The method is based on the cost of the internal economy of water in an industrial plant. It may be used to compare the relative productivity of water in depleting and nondepleting uses, or to compare the returns to industry with the costs of public development of a water supply. Some estimates of marginal value are derived from data supplied by the Bethlehem Steel Company plant at Sparrows Point, Maryland. (Seneca-Rutgers)
W69-02536

GROUNDWATER MANAGEMENT UNDER QUADRATIC CRITERION FUNCTIONS,
Missouri Univ., Columbia. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-02537

DYNAMIC ECONOMIC EFFICIENCY OF WATER QUALITY STANDARDS OR CHARGES,
Washington Univ., Seattle.
For primary bibliographic entry see Field 05D.
For abstract, see .
W69-02549

A RECONNAISSANCE STUDY OF THE CHESAPEAKE BAY,
Department of Housing and Urban Development, Washington, D. C.
Paul R. Farragut.
Regional Planning Council, Baltimore, Maryland, 1968, 114 pp, 6 fig, 2 append, 25 ref.

Descriptors: Water resource management, Project planning, Formulation, *Future planning, Water quality control, Thermal pollution, Stream standards, Sate governments, Administrative agencies, Jurisdiction, Land use, Flood damage, Erosion, Sedimentation, *State jurisdiction.
Identifiers: Baltimore (Maryland), Chesapeake Bay, Susquehanna River.

The report discussed present and future problems involved the region's shoreline attempting to synthesize many of the narrowly focused technical studies completed in the past. Physical problems, such as erosion, sedimentation, tidal flooding, and water characteristics, such as excessive nutrients, polluted shellfish areas, thermal pollution, plant and animal nuisances and the importance of the wetlands and the Susquehanna River are considered. A chapter on water quality contrasts the present condition of streams with the highest protected use as defined by the state's water quality standards. State agencies having responsibilities relating to the bay resources are identified. The jurisdiction and extent of their involvement in specific problems is considered. An attempt is made to recognize the many important interrelationships existing along the bay shoreline at the interface of land at water. Present water quality standards designate 'zones' of water quality in different areas which exert an influence on land use. The entire study focuses on the water resource of the Chesapeake Bay in an attempt to facilitate accurate and complete waterfront planning. (Gargola-Chicago)
W69-02771

VERMILION RIVER BASIN STUDY,
Illinois State Div. of Waterways, Springfield.
Bruce Barker, John B. Carlisle, and Raymond Nyberg.
Illinois, Public Works and Buildings Dept., Springfield, Ill. 1967, 20 tab, 22 fig, 99 pp.

Descriptors: *River basin development, Administrative agencies, Hydrologic data, Water supply, Water quality, Recreation, Flood damage, Water resource management, Drainage districts, Irrigation, Project planning, *Adoption of practices,

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Waste water treatment, *Water quality control, Flood control, Municipal water supply.
Identifiers: Wabash Basin, Vermilion Basin.

Certain problems -- poor natural drainage, inadequate low flows, limited supply of potential water storage sites and a shortage of natural forests, scenic lands and waters for outdoor recreation -- are discussed in relation to the physical geography of the area. Outlined are the economic aspects of agriculture and industry in the basin. Pertinent hydrologic data is stated so that meaningful estimates can be made of the quantities of water available in surface streams or groundwater aquifers, and the frequency of drought, floods and rainstorms. The possibility of wastewater treatment facilities for attainment of stream quality standards is investigated. Four points of stream quality requirements are enumerated, but it is noted that additional criteria are necessary for the protection and maintenance of a fish population. Potential sources of water supply -- groundwater, surface water, well water -- are suggested to meet the future increased demand for water. Significant factors in drainage are considered within discussion of the flood problem. It is recommended that local governments carry out flood damage reduction plans rather than state or federal agencies. In conclusion, the study indicates that the water resources of the Vermilion Basin have been wisely developed and well managed up to the present and the work need only continue. (Gargola-Chicago)
W69-02772

KANKAKEE RIVER BASIN STUDY,
Illinois State Bureau of Water Resources, Springfield.
Bruce Barker, John B. Carlisle, and Raymond Nyberg.
Illinois Bureau of Water Resources, 1967, 76 pp, 39 fig, 27 tab, 65 ref.

Descriptors: *River basin development, Administrative agencies, Drainage, Flood control, Municipal water supply, Hydrologic data, *Water quality control, Stream quality, Irrigation, Project planning, *Adoption of practices, Recreation, Public benefits, *Water resource management, Drainage districts, Wastewater treatment, Project purposes.
Identifiers: Kankakee River Basin, Iroquois River, Illinois.

The study includes discussion of all major aspects of water use and management which will be affected by changing conditions in the future. Considered are population growth, municipal water demand, water quality control, water-oriented recreation, flood damage control, agricultural drainage, and irrigation. Certain recommendations are made from the findings relating to these factors: (1) water supplies for the anticipated urban fringe area in the northeast portion of the basin can be obtained from shallow dolomite aquifers providing wells are properly constructed, developed, and spaced; (2) the natural water quality in the basin is good and can be maintained by adequate treatment of municipal and industrial wastes; (3) the Kankakee and Iroquois rivers should be developed as recreational waterways to accommodate pleasure boating, fishing and related activities; and (4) flood damage control through land use management in all areas of the basin subject to urbanization and construction of a levee to protect the developed area of Watseka is recommended. The major demands on the water resources of the Kankakee basin will occur from the expansion of industry and urban population. These demands can be met through implementation of the above suggestions, and insure continued economic growth.
W69-02773

THE SOCIOLOGIC AND ECONOMIC ASPECTS OF WATER RESOURCES AND WATER RESOURCES PLANNING IN GEORGIA,
Georgia State Planning Bureau, Atlanta.
For primary bibliographic entry see Field 06B.
For abstract, see .
W69-02774

PLANNING FOR WATER RESOURCE MANAGEMENT IN ARLINGTON HEIGHTS, ILLINOIS,
Arlington Heights, Ill.
John R. Sheaffer, James E. Hackett, Emil Oelberg, and George Davis.
Wheaton, Ill., 1967, 36 pp, 15 fig.

Descriptors: *Water resource management, Political constraints, *Project planning, Future planning, *Local governments, Community development, Storm runoff, Floodwater, Typography, Aquifers, Groundwater, Surface water, Recreation, *Water quality control.
Identifiers: Arlington Heights, Weller Creek, McDonald Creek, Tinley Moraine.

The foundation of a resource management program is the physical setting. This serves to define the potential for water resource management and assists in the establishment of the range of development possibilities. The physical setting of Arlington Heights, Illinois is explored. The topography, distribution of materials, sands and gravels, ground and surface water resources are outlined. Management considerations resulting from these particular physical settings are discussed and certain suggestions put forth. Five special project areas, designated as focal points for water resource management are considered: (1) solid waste and recreation site south of Nichols Road, (2) area west of Tinley Moraine adjacent to Salt Creek, (3) industrial zone south of Dundee Road, (4) McDonald Creek Parkway Development, and (5) Weller Creek north of Central Road. In conclusion, nine recommendations are made for future water resource management in the area and for special projects. Recent policy statement by the Metropolitan Sanitary District of Greater Chicago will greatly affect surface water management in Arlington Heights; the ramification of this are outlined. (Gargola-Chicago)
W69-02778

LITTLE CALUMET RIVER STUDY,
Lake Michigan Region Planning Council, Inc., Chicago, Ill.
George N. Hall, and Richard W. Cramer.
Lake Michigan Region Planning Council, Project 66-1, 1968, 71 p, 1 map, 9 illus, 20 fig, 27 ref.

Descriptors: *River basin development, *Regional planning, Urbanization, City planning, Flood plain zoning, Local governments, Project planning, Recreation demand, Social needs, Water quality, Flood control, *Project purposes, Future planning, *Community development, Land uses, Administrative agencies, Future planning, Formulation.
Identifiers: Little Calumet River, Hammond (Indiana), Historical development, Urban corridor.

The study has been conducted with certain goals and policies in mind: (1) constant consideration of the interrelationship between significant factors, (2) environmental preservation and enhancement, and (3) transformation of the river related region to a productive environment. The regions natural characteristics, formations, and resources are explored with discussion of the regions previous human development and present circumstances. The region is aesthetically and physically unattractive due to considerable air and water pollution. The responsibility for this situation lies basically with the local governments and citizens living in the area. A major problem is the lack of adequate recreation and park space closely related to urban housing and activity areas. Improvement of the urban corridor is dealt with, in design analysis and planning considerations. Flood control and water quality problems and suggested solutions are reviewed. The most important consideration in dealing with this situation is that the potential of the area be realized and not hampered by narrow single purpose projects. Various planning concepts, the river park concept, the scenic way concept, and the regional city concept are outlined and diagrammed. Design possibilities for certain areas are put forth and suggestions made for their implementation. (Gargola-Chicago)
W69-02779

6E. Water Law and Institutions

DRAINAGE BY COUNTIES.

Fla Stat Sec 157 (1967).

Descriptors: *Canals, *Conduits, Culverts, *Drainage systems, Maintenance, Assessments, Bids, Construction costs, Condemnation value, Taxes, Legislation.

Section 157.01 permits that a majority of those owning land through which a ditch or canal might flow to petition the county commission for the purpose of making said ditch or canal a public ditch, drain or canal. Section 157.02 permits the county commission to grant the request of the petition at its discretion. Section 157.03 provides for the appointment of three freeholders to obtain bids for the establishing of the public waterway. Section 157.04 requires that contractor working on the drainage ditch give a performance bond. Section 157.05 states that the work should be done under the supervision of the committee of three freeholders. Section 157.06 provides for tax assessments on the property adjacent to the drainage ditch, and also stipulates that the committee shall view the land before the work begins. Section 157.10 provides that the provisions of the entire chapter shall apply to lateral ditches and drains that may become necessary or expedient for the drainage of adjacent land. Section 157.11 provides for the widening or deepening of any lateral ditch upon the petition of one-fourth of the adjacent landowners. Section 157.16 provides for the assessment against the benefiting landowners for the costs of enlarging or deepening drains or auxiliaries. Section 157.17 provides for assessments to maintain the drains and section 157.19 provides that if the costs exceed estimates, the excess shall be assessed against the landowners. (Dann-Fla)
W69-02412

AN ACT TO ENCOURAGE LANDOWNERS TO MAKE LAND AND WATER AVAILABLE TO THE PUBLIC BY LIMITING LIABILITY IN CONNECTION THEREWITH.
Iowa Laws Ch H 151 (1967).

Descriptors: *Iowa, Land tenure, *Land, Marshes, Grasslands, *Watercourses, Water, *Recreation, Fishing, Skiing, Boating, Public benefits, Prices, Safety, Hazards, State governments, Administrative agencies, Legislation.
Identifiers: Limited liability, Attractive nuisance.

Iowa, by statute, has limited the liability of private owners of land and water areas to persons coming upon such land for public recreational purposes in order to encourage such owners to make their property available for public recreational purposes. The term 'land', as used in the Act, includes marshlands, water, and watercourses. 'Recreational purpose' has a broad scope including hunting, fishing, swimming, camping, and winter sports. The owner of such private land owes no duty, to persons entering for recreational purposes to keep such premises safe or to warn of a dangerous condition or structure on such premises. Additionally, if he permits, without charge, any person to use his property for such purposes, he does not warrant that the premises are safe for any purpose, confer the legal status of invitee or licensee upon such person, or assume responsibility for any injury to that person or his property. The Act, however, in no way limits his liability for willful or malicious failure to guard or warn against a dangerous condition or structure or for injury suffered where he charges the person entering upon his land for recreational purposes. (Geraghty-Fla)
W69-02413

WATER AND WATER RIGHTS - WATER POLLUTION AND QUALITY CONTROLS,
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02414

LABBADIN V BAILEY (WATER LEVEL).

147 Conn 82; 157 A 2d 237-241 (1959).

Descriptors: Judicial decisions, Legal aspects, *Connecticut, Riparian land, Water rights, Prescriptive rights, Water level, *Riparian water loss, Lakes, Dams, Maintenance, Operation and Maintenance.
Identifiers: Deed covenants, Artificial lakes, Private dams.

Plaintiffs and defendants received title to their land, which abbutted an artificial lake, from a common grantor. A dam situated on defendants' land impounded the waters of the lake. The deed from the grantor to the plaintiffs provided that the grantor, or his successors would maintain the dam at its present level and keep it in good repair. The plaintiffs sought an injunction and damages for depreciation in the value of their properties caused by defendants' release of water through the dam. The court, assuming arguendo that the provisions in the deed constituted a convenant running with the land, held that a release of water which did not lower the level of the dam but did lower the level of the lake was not a breach of the covenant. Plaintiffs cannot compel the defendants to repair and maintain the dam on the basis of prescriptive rights acquired through the use of the lake in the absence of an express agreement to do so. (Molica-Fla)
W69-02428

WEISS V BOARD OF COMMISSIONERS FOR PONTCHARTRAIN LEVEE DIST (OWNERSHIP OF SHORE LANDS).

115 So 2d 804-808 (1959).

Descriptors: *Louisiana, *Shores, Lake shores, Public rights, Levees, Ownership of beds, Legal aspects, Judicial decisions, *Eminent domain, Rivers, Market value, *Property value, Lakes, High water mark.
Identifiers: Servitude, *Lake Pontchartrain.

This action involved lands appropriated by defendant Levee District to construct a levee on Lake Pontchartrain. The defendant questioned the validity of the plaintiff's title claiming that the property was sea shore and therefore not susceptible of private ownership under the Civil Code. Under the code, a servitude is imposed for the public utility on shores of navigable waters. The court held that the lands were not burdened with the servitude because they did not border or rim the lake but lay behind a highway which formed a protecting levee therefor and prevented inundation except during severe storms, and no portion was closer to the lake's shoreline than 200 feet. (Horner-Fla)
W69-02435

BRIDGES V THOMAS (STREAM AS A BOUNDARY).

118 So 2d 549-553 (1960).

Descriptors: *Real property, *Boundaries (Property), Riparian land, Legal aspects, Water courses (Legal), Judicial decisions, Natural streams.
Identifiers: *Courses and distances.

Plaintiff sold certain property to defendant without surveying it. The parcel was described as being bounded by a creek which was estimated to be 148 feet north of the south boundary. A subsequent survey showed that the creek was actually 198 feet north of the south boundary. The plaintiff sued to have the deed reformed to reduce the quantity of land so that the boundary would be 148 feet north of the south boundary rather than at the creek. The court held that natural landmarks as a general rule prevail over courses and distances for the purpose of determining the location of a boundary even though this means either the shortening or lengthening of distance. If marked trees or water courses be called for in the deed, distances must be lengthened or shortened and courses varied so as to conform to those objects. (Horner-Fla)
W69-02436

TENNESSEE GAS TRANSMISSION COMPANY V STATE (RIVER BEDS).

335 SW 2d 312-315 (1960).

Descriptors: *Mississippi River, River beds, Water rights, *Federal-state water rights conflicts, *State jurisdiction, Arkansas, Navigable waters, *Ownership of beds, State government, Administrative agencies, Permits, Reservation doctrine, Oil industry, Natural gas, Rivers and Harbors Act, Judicial decisions.
Identifiers: Natural Gas Act, Federal Power Commission.

Several gas companies laid pipelines carrying natural gas underneath the bed of the Mississippi River believing they had obtained proper authorization. In this suit, involving the interpretation of several Federal and Arkansas statutes as well as the common law, the state of Arkansas asked for nominal damages from the gas companies for laying the pipelines under the Mississippi River without the requisite state consent. The court held that the gas companies were liable to the state for nominal damages on several grounds: (1) The states own the beds of navigable waters situated within their boundaries subject only to the paramount rights of Congress to control navigation. (2) Since the state officers granting easements to the gas companies were without the requisite authority to do so, no state assent was obtained. (3) This action brought by the state was not improper as tending to interfere with interstate commerce. (4) While the gas companies had the right of eminent domain, they here failed to properly exercise it. (Carruthers-Fla)
W69-02437

NAIMISH V WAROLOW (RIPARIAN RIGHTS).

362 Mich 198 106 NW 2d 770-774 (1961).

Descriptors: Michigan, *Riparian rights, Water levels, Water level fluctuations, Inland waterways, *Lake beds, Drains, Drainage, Farms, Land reclamation, Water rights, Land ownership, Water, Water courses, Judicial decisions.

The defendants were recent purchasers of farm property bordering on Michigan's Duck Lake. Plaintiffs, adjoining landowners with property fronting on the lake, instigated this action to enjoin defendants from attempting to fill a portion of the lake bed in order to gain better access to certain portions of their property. Plaintiffs alleged that such activity cut off access to a bay by which plaintiffs and plaintiffs' predecessors in title had consistently had access to the lake for 34 years. The court held that were the former owners of property adjoining the lake had agreed in 1921 to the construction of a drain which raised the water level of the lake, an action in equitable estoppel was appropriate as against defendants since their activity would interfere with the riparian rights not only of plaintiffs but also of other landowners with property on the lake. (Carruthers-Fla)
W69-02441

APPLICATION AND PETITION OF HUIE.
218 NYS 2d 791-793 (1961).

Descriptors: New York, *Judicial decisions, *Diversion, *Easements, Rights-of-way, Eminent domain, Compensation, Property values, Administrative agencies, Legal aspects.
Identifiers: Nonappurtenant right-of-way.

In an eminent domain action, commissioners awarded plaintiff damages for harm to his bungalow business and the taking of his easement when defendant city diverted the river. The commissioners also awarded the respondent Fire District $5,000 for the decrease in value of its non-riparian land, and $7,500 for the taking of the district's sixteen foot, nonappurtenant, restricted use right of way to the river. The city appealed the findings. The court affirmed the commissioners' determination that the plaintiff's bungalow colony operation was a business within the meaning of Title K of the Administrative Code of New York City (the Water Supply Act). Damage to the business was compensible, under the act, even though the plaintiff owned no riparian land and merely enjoyed the use of a limited easement to the river. The court declared that the damages fixed as compensation for the decrease in value of the Fire District's land and right of way were greatly excessive. More than vague and unresponsive expert testimony is required when it is suggested that the city compensate an owner for the disparity in his land's market value after diversion of a river, especially when the land allegedly affected is some distance from the river. Very little adequate proof or legal basis supportive of the award made to compensate the Fire District's loss of its peculiar and limited easement was demonstrated. (Blunt-Fla)
W69-02445

INHABITANTS OF TOWN OF WINTHROP V FOSTER (OWNERSHIP OF UNDERWATER LANDS).

170 A 2d 152-156 (Me 1961).

Descriptors: *Maine, Judicial decisions, *Docks, *Right-of-way, Lake beds, Surveys, *Ownership of beds, Boundary disputes, Relative rights, Water law, Cities.
Identifiers: Injunctions.

Plaintiff town sued for a mandatory injunction obligating the defendant to remove a wharf. The town contended that it owned an easement or fee in the lake bottom. The evidence submitted by the town was confusing and conclusionary in the eyes of the trial judge. The decision at trial was for the defendant, the town appealed, and the Supreme Court of Maine affirmed. This court said that the record did not sustain the town's contention that the trial judge was incorrect in ruling that the town had not carried the burden of proof required of it. More than the opinionated testimony of the town engineer, backed by sparse and inconclusive evidence, is required before the town may demand judicial cognizance of its claim of ownership in the face of the undisputed evidence of a long series of wharves which stood uncontested for many years on the same site. (Blunt-Fla)
W69-02452

POTTER V CAROLINA WATER COMPANY (DUTY TO MAINTAIN PRESSURE IN FIRE HYDRANTS).

116 SE 2d 374-380 (NC 1960).

Descriptors: *Water supply, Hydrants, *Water pressure, Burning, *Municipal water, Judicial decisions, Legal aspects.

Plaintiff sued water company to recover for fire damage to plaintiff's property which ascertedly would not have occurred had the defendant water company complied with its contractual duty to the municipality of maintaining water pressure at the hydrant. The court held that this did constitute an actionable breach of contract by the water company. An agreement to provide and maintain the fire hydrants is analogous to the sale of an article by a manufacturer for a particular purpose--to provide fire protection. The article must be reasonably appropriate for the purpose for which it is purchased. (Rief-Fla)
W69-02453

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GRANTS OF SWAMP AND OVERFLOWED LANDS.
43 USCA Secs 981-994, pp 332-376.

Descriptors: California, Arkansas, Minnesota, Oregon, Missouri, Louisiana, Wisconsin, Marshes, Wetlands, *Swamps, Land reclamation, Land ownership, Land classification, *Federal-state water rights conflicts, Ownership of beds, *Prior appropriation, Patents, Federal government, States, Levels, Drains, *Legislation.
Identifiers: *Overflowed lands, Indemnity to states.

The statute deals generally with recognition by the Federal Government of the prior rights of the states in regard to the swamplands within their boundaries. Section 981 is concerned with a state's right of indemnity for prior purchases of swampland from the Federal Government. Section 982 enunciates a policy to aid the states in reclaiming swamplands. Section 983 deals with the duties of the Secretary of the Interior under this act. Section 984 sets up standards for inclusion into plats and lists of swamp and overflowed lands which the act covers. Section 985 deals with patents to prior purchasers. Section 986 deals with the mode of selection and confirmation of swamp and overflowed lands coming under the act. Sections 987-994 deal with the specific application of the bove sections to the states of California, Minnesota and Oregon, Missouri, Arkansas, Louisiana and Wisconsin, respectively. (Carruthers-Fla)
W69-02458

RIGHTS OF FISHING, BOATING, BATHING, OR THE LIKE IN INLAND LAKES,
C. C. Marvel.
57 ALR 2d 569-596.

Descriptors: Judicial decisions, Great ponds, *Lakes, Lake beds, Ownership of beds, *Riparian rights, Riparian land, *Fishing, Boating, *Public rights.
Identifiers: Public Trust Doctrine.

Generally the public has rights in the use of the surface of public, or navigable waters while the owner of the soil beneath private or non-navigable waters has an exclusive right to the use of the surface thereof. This is also the rule for fishing rights. Cases involving public or navigable lakes, and public rights therein are set out. The conflict between public and riparian rights is discussed. Cases on the Great Lakes and great ponds of New England are discussed. Owners of beds of private lakes, especially those which are non-navigable in fact, have exclusive rights to the use of the waters. The remedies of trespass and injunction to protect these rights are discussed. Riparian owners, who do not own any of the lake bed are generally held not to have rights of fishing, boating and bathing. Cases involving conflicts between multiple owners of lake bottoms, where such ownership is not based on riparian rights, are discussed. Each is allowed to use the water above the portion of the bed he owns. However, the owners of portions of a lake bed by virtue of riparian rights all have common right to use the entire lake. Finally, cases involving prescriptive rights and dedication are examined. (Williams-Fla)
W69-02460

AN ACT CONCERNING THE ELIMINATION OF POLLUTION OF THE WATERS OF THE STATE.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02462

AN ACT CONCERNING THE ELIMINATION OF POLLUTION OF THE WATERS OF THE STATE.
For primary bibliographic entry see Field 05G.
For abstract, see .
W69-02463

SHOREHAVEN GOLF CLUB, INC V WATER RESOURCES COMMISSION (DENIAL OF DREDGING APPLICATION).

146 Conn 619, 153 A 2d 444-448 (1959).

Descriptors: *Connecticut, *Administrative decisions, Judicial decisions, Ownership of beds, Permits, State governments, Channels, *Channel improvement, *Dredging, Desilting, Beds, Navigable waters, Riparian waters, Riparian rights, Regulation, Administrative agencies.

Plaintiffs applied to defendant-commission for designation of a channel under trial waters and for permission to dredge and remove materials from it. The defendant denied the application. Plaintiffs brought suit to force defendants to act favorably on their application. The court held that when plaintiffs urged their plan as the only one feasible and the defendant denied it, defendant was not under any duty to make suggested changes or to grant a rehearing for that purpose. Since the proposed operation was in essence a commercial venture to remove and sell submerged sand and gravel presently in the proposed channel and to develop plaintiffs' shore properties at a very modest cost to them, the defendant properly denied the application as an unwarranted taking of state-owned underwater lands for private purposes. (Scott-Fla)
W69-02464

DEPARTMENT OF WATER RESOURCES ACT.
NC Gen Stat sec 143-351--143-355 (1967).

Descriptors: *North Carolina, Legislation, State governments, *Water resources, Natural resources, Water conservation, Water policy, Water pollution, *Water resources development, Water utilization, Planning, Governments, Research and development, Water utilization.

The Department of Water Resources was created to coordinate the state's water resources activities; to devise plans and policies; and to perform the research and administrative functions necessary to insure improvement in the methods of conserving, developing and using those resources. The department shall be governed by the Board of Water Resources which will consist of seven members to be appointed by the governor. The board shall organize the department into a Division of Water Pollution Control, a Division of Navigable Waterways, and such other divisions or units as it deems necessary. The act creating the department and the board lists the ordinary powers and duties of the board, which include conservation planning and education; advising the governor; recommending relevant legislation; and adopting such rules and regulations as may be necessary to carry out the purposes of the act. The board may also declare a water emergency, in which case it had additional powers and responsibilities. Powers, duties, functions, and responsibilities relating to water resources formerly vested in the Department of Conservation and Development are transferred to the Department of Water Resources. (Scott-Fla)
W69-02467

WATER RESOURCES ADMINISTRATION IN DELAWARE,
Delaware Univ., Newark. Urban Affairs Div.
Roger S. Hoeh.
Research Project Partial Technical Completion Report to Office of Water Resources Research, Department of the Interior, Washington, D. C., November 1, 1968, 4p. OWRR Project A-003-Del.

Descriptors: Legal framework, *Administrative organization, *Intergovernmental relations, Water resources policy, Water rights, Interagency coordination, *Delaware River Basin Commission, Intrastate water programs, Interstate cooperation.

The legal framework within which water resources are administered inhibits and complicates the formulation of a comprehensive, statewide policy on water resources. It is especially deficient with regard to definition of water rights, their use and allocation. Future legal problems will be concerned with (1) defining the scope of water rights, (2) providing a mechanism for implementing and enforcing a water resources plan and (3) coordinating policies of water-oriented state agencies. Deficiencies in the administrative framework also inhibit the formulation of a statewide policy on water resources. There is a lack of formal coordination between states agencies concerned with water resources. There should be a formal program – coordinating body, or a merger of existing agencies under a department of natural resources with a director responsible for coordinating policy. The Delaware River Basin Commission is the focal point of intergovernmental relations in the area of water resources. Delaware's interest can be endangered by some of the aforementioned weaknesses of its legal and administrative framework. The lack of formal intrastate program coordination, the absence of a single water resource policy, and the absence of any formal advisory body to assist the state's delegate to the DRBC all combined to make coordination between DRBC and state programs difficult. Aforementioned administrative change, and an advisory body or its equivalent, could correct this situation.
W69-02469

CONGRESSIONAL HANDLING OF WATER RESOURCES,
Library of Congress, Washington, D. C. Legislative Reference Service.
Theodore M. Schad, and Elizabeth Boswell.
Water Resources Research, Vol 4, No 5, 849-863, Oct 1968. 15 p, 2 tab, 24 ref.

Descriptors: *Legislation, *Water Resources Research Act, Water pollution control, Water resources development.
Identifiers: *Congressional Organization, Corps of Engineers, Bureau of Reclamation, *Federal project policy, Appropriations committees.

In the 89th Congress, 1289 legislative measures more than 5% of the total number introduced, were concerned with water resources. The United States Congress, patterned on experience in Great Britain, embodies the theory of separation of powers expressed in the United States Constitution. To handle the heavy legislative work load proposed legislation is considered first in committee before debate on the floor. The committees thus have great power in shaping the nature of legislation. Under the present committee structure many factors other than water resources have been given predominance. As a result, under the rules of the Senate and House of Representatives governing referral of bills, water resources measures were referred to 11 committees in the Senate and 1 committees in the House of Representatives. Although there are some instances where inconsistent policies have evolved in water resources programs because the legislation emanated from different committees, there are others where committees have cut across jurisdictional lines to propose legislation that provides uniform policies applicable to all Federal programs. (Seneca-Rutgers)
W69-02532

SOME INSTITUTIONAL ASPECTS OF WATER RESOURCE DEVELOPMENT: A CASE STUDY OF MONTANA,
Montana State Univ., Bozeman.
Chennat Gopalakrishnan.
Proceedings of the Third Annual American Water Resources Conference, 1967, pp 215-221, 7 p.

Descriptors: *Montana, *Institutional constraints, Political constraints, *Water resource development, Legal aspects, Water law, Federal government, Legislation, Prior appropriation, Water rights, Conservation, State government, Administrative agencies, Political aspects, Dam construction.
Identifiers: Conservancy districts.

This article discusses some of the institutional aspects related to Montana's water resource development. It indicates how these institutional impediments have slowed down considerably the optimum development of the state's water resources. The author concludes that the success of a program of water resource development depends upon a host of institutional factors as well as economic considerations. The search for efficiency in water utilization through water transfer can be successful only if these institutional aspects are recognized. In order to overcome most of the institutional blocks, in addition to removing the legal and administrative handicaps, concerted effort should be undertaken to educate people at the 'grass roots' level. The results of technical research have to be passed on to the general public in a form that is fully comprehensible to them. (Seneca-Rutgers)
W69-02542

WATER RIGHTS LITIGATION AND LEGISLATION, 1967,
Taylor and Smith, San Bernardino, Calif.
Edward F. Taylor.
J Amer Water Works Ass, Vol 60, No 9, pp 1001-1014, Sept 1968. 14 p, 51 ref.

Descriptors: *Water rights, *Water law, *Legal aspects, *Legislation, Water supply, Jurisdiction, Judicial decisions, Riparian rights, States (Geographical), Water allocation (Policy), Water pollution, Groundwater, Water resources, Demineralization, Water districts, Bibliographies, *Water shortage.
Identifiers: *Litigation, Colorado River Storage Proj, Waste Water reclamation, Pollution control.

As the United States' population multiplies and increasingly migrates to the cities, water resources take on more vital significance. Already in many areas water is a previous commodity. Water acquisition, with the attendant problems of conservation, pollution, and reclamation, faces city leaders throughout the nation. Not only must the thirst of the population be quenched, but also the needs of industry. This report scans recent national, regional, and state developments in the area of water problems. Developments in water pollution control, waste water reclamation, and salt water conversion are discussed. Recent acts of water legislation by several states are named, and notable cases of water litigation are cited. Problems in water district financing, organization, and annexation are discussed. (USBR)
W69-02560

A FEDERAL WATER RESOURCES COUNCIL APPROACH TO WATER AND RELATED LAND RESOURCES PLANNING,
Water Resources Council, Washington, D. C.
Reuben J. Johnson.
Proc Ser No 3, Symp Amer Water Resour Ass, San Francisco, Calif, pp 184-196, Nov 1967. 13 p, 4 fig, 4 ref.

Descriptors: *Water resources, *Land resources, *Planning, River basin development, Resources, Water utilization, River basins, River basin commissions, Interstate compacts, Resource development, Water management (Applied), Federal government, Interstate commissions.
Identifiers: *Water resources management, *Water Resources Council.

The Water Resources Planning Act of July 1965 provides for a coordinated approach to planning the nation's water and related land resources. This is accomplished through establishment of a Water Resources Council, consisting of those Federal agencies involved in water resource programs; regional and river basin commissions that provide for states as members; and providing financial assistance to states, enabling increased state participation in planning. Specific assignments of the Council include: (1) establishing principles, standards, and procedures for performing comprehensive water resources planning, (2) assessing the national water resources situation, (3) establishing river basin commissions, and (4) reviewing and coordinating all water resources planning on the local and national level. Accomplishments of the Council and commissions are discussed. (USBR)
W69-02589

WATER-USE LAW IN ILLINOIS,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
Fred Mann, Harold Ellis, and N. G. P. Krausz.
Agricultural Experiment Station Bull 703, 1964. 332 p, 3 fig.

Descriptors: *Illinois, Natural streams, Percolating water, Subsurface waters, Springs, Surface waters, Drainage, Remedies, Irrigation, Water pollution, *Administrative agencies, *Interstate compacts, Water resources, Water law, Riparian land, *Riparian rights, Riparian waters, Water rights, Watercourses (Legal).

As water resources become economically more important, the legal structure governing rights and responsibilities in utilizing and developing these resources becomes more complex. Additional legislation may be needed to conserve water and encourage its most effective use, and sound legislation can best come from an informed public. In order to promote better understanding of water use law in Illinois, the Illinois Agricultural Experiment Station and the Resource Development Economics Division, Economic Research Service, U S Department of Agriculture, undertook the study reported here. An increasing number of problems and potential conflicts concerning the use, disposition, control and development of water resources can be expected in the years ahead. The book deals with these and numerous related subjects, including applicable federal laws and inter-state and international considerations. Laws of other states are also discussed to indicate possible directions in areas where Illinois Court decisions are unclear. The book contains an appendix of forms, recent court cases, lists of public streams and lakes, sanitary districts, and state projects. (Kahle-Fla)
W69-02624

CHAPTERS 1-4: WATER-USE LAWS IN ILLINOIS; SOURCE OF THE LAW; STATE WATER-USE POLICY; TYPES OF WATER SOURCES,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
Fred Mann, Harold Ellis, and N. G. P. Krausz.
In Water-Use Law in Illinois, pp 1-8, 1964. 8 p. (for main entry see W69-02624).

Descriptors: *Water consumption, *Illinois, Agriculture, Municipal waters, Industrial water, Sewage treatment, Hydrologic cycle, Legal aspects, Irrigation, *Economic prediction, *Water law, Water rights, Surface runoff, Watercourses (Legal), Groundwater.

According to a 1959 Governor's Report, the mean daily surface and groundwater supply available to Illinois is 43 billion gallons per day. Although this is 5 times the amount of present usage, the problem is that it is not uniformly available in place, time, or for municipal uses, with a substantial increase in industrial and recreational uses. There has been no rapid spread of irrigation use, but this area remains one of the greatest uncertainities for the state. 5 per cent of the population presently is not served with treatment plants, with three-fourths of these being along interstate water. The sources of Illinois water law are some rather disconnected legislation dealing with one phase or another of water use superimposed upon the common law of the state. There are few reported court decisions and thus the overall effect of applicable laws is often difficult to determine. The Illinois Courts have given little recognition to the hydrologic cycle. They have consistently classified sources as natural watercourses, percolating groundwater, or surface water, with different rules for different sources. (Kahle-Fla)
W69-02625

CHAPTER 5: NATURAL WATERCOURSES,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
Fred Mann, Harold Ellis, and N. G. P. Krausz.
In Water-Use Law in Illinois, pp 9-130, 1964. 122 p, 1 fig. (for main entry see W69-02624).

Descriptors: Natural streams, *Riparian rights, Developed waters, Flooding, Artificial flow, Public benefits, Navigable waters, Lakes, Beds, *Federal jurisdiction, *State jurisdiction, *Illinois, Water law, Riparian waters.

Natural watercourses are defined according to Illinois Law, which distinguishes them from other related types of water, eg, overflow waters. Illinois, in the 1842 case of Evans v Merriweather, adopted the doctrine of riparian rights, with some restrictions of reasonableness. Natural uses are distinguished from artificial uses, with all natural uses being reasonable per se. Alterations in the quantity and quality of flow, as well as pollution, have been held to be unreasonable uses. As a general rule, a grant of riparian land conveys to the center thread of the stream. Bed ownership gives exclusive right to hunt and fish over the bed, even though the stream may be open to public navigation. The public has an easement of navigation in all waters navigable in fact. In some cases this is determined as of the date of Illinois' statehood. Upon statehood, Illinois acquired ownership of beds of all navigable waters, but none of the non-navigable waters, within its boundaries. For easement of navigation purposes, navigability is determined by federal criteria. However, Illinois has relinquished ownership of beds to riparian owners subject to the paramount powers of the federal government to improve interstate commerce. State jurisdiction over natural watercourses is outlined here, but discussed more fully in a later chapter. (Kahle-Fla)
W69-02626

CHAPTERS 6-10: PERCOLATING GROUNDWATER; SUBTERRANEAN WATERCOURSES; SPRINGS; SURFACE WATER; DRAINAGE,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
Fred Mann, Harold Ellis, and N. G. P. Krausz.
In Water-Use Law in Illinois, pp 130-143, 1964. 14 p. (for main entry see W69-02624).

Descriptors: *Percolating water, Subsurface waters, *Springs, Natural flow doctrine, *Illinois, Legal aspects, *Drainage, Drainage practices, Water law, Overlying proprietor.

The law with regard to percolating groundwater seems to be that it is part of the land itself, and belongs absolutely to the overlying owner to make whatever use he sees fit. The court has indicated, however, that it would not permit a malicious interference by use. There are no direct decisions as to questions regarding subterranean watercourses and springs. Indications are that subterranean watercourses are subject to the same rules as surface watercourses with a presumption, however, that subsurface waters are percolating waters. Springs are probably subject to the same rules as the source from which they derive their flow. All water on the surface not in a natural watercourse is considered surface water. This includes the overflow of at least the smaller rivers, though there is some doubt as to the overflow of large rivers. Illinois drainage rules generally follow the civil-law rule of natural flow, modified somewhat by the 1955 Code, which provides for drainage district organization and operation. (Kahle-Fla)
W69-02627

CHAPTER 11: WATER-USE REGULATION AND RELATED FUNCTIONS OF STATE AND LOCAL BODIES,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
Fred Mann, Harold Ellis, and N. G. P. Krausz.
In Water-Use Law in Illinois, pp 143-191, 1964. 49 p, 1 fig. (for main entry see W69-02624).

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Descriptors: *Illinois, *Administrative agencies, Interagency cooperation, *Regulation, Boating regulations, Drainage districts, Building codes, Municipal water, *Legislation, Legal aspects, Conservation, Permits, Water law.

Organizations in Illinois involved in water use regulation and related functions fall into four categories: (1) state departments, boards, and commissions; (2) local governmental units; (3) special district organizations created under permissive legislation; and (4) special district organizations created by statute. In the first category, the Dept. of Public Works and Buildings, with a general supervisory and regulatory power over all public waters, is the most directly concerned with water use regulation. This and the other departments and boards are discussed in detail. The second category includes municipalities, counties, and townships. The jurisdiction and powers of each are discussed. The third category includes soil and conservation districts, public water districts, drainage districts etc. They have regulatory powers over the use of water. Districts with more extensive powers include river conservancy districts and water authorities. Under the final heading are found port districts and certain sanitary and park districts. They are distinguished from other organizations concerned with water use in that they are not uniform throughout the state, but are unique and usually limited to a particular area, generally because of some unusal feature involving the water resources of that area. (Kahle-Fla)
W69-02628

CHAPTER 12: REMEDIES,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
Fred Mann, Harold Ellis, and N. G. P. Krausz.
Water-Use-Law in Illinois, pp 191-228, 1964. 38 p. (For main entry see W69-02624).

Descriptors: *Illinois, *Remedies, *Water rights, Riparian rights, Legal aspects, Pollution, Administrative decisions, Abatement, Legislation, Adjudication procedure, Water law, Legal aspects.

Remedies for the invasion of legally protected water rights are discussed. Where natural watercourses are involved, one must be a riparian owner or claim under one to bring an action. Actions for damages include alteration of quantity or quality of flow. The latter may include pollution or change of temperature. A court of equity may grant an injunction if it is shown that damages are inadequate and the injured party will suffer irreparable harm unless relief is granted. Equity may grant an injunction without a prior adjudication at law if plaintiff's right is clear and the disturbance by the defendant is an irreparable injury at law. Courts have by statute the power to order the abatement of a public nuisance by the sheriff at the defendant's expense where a criminal conviction has been obtained. In addition to these remedies various administrative remedies are available. Action by the proper department, board, or agency often settles disputes without litigation. Illinois also has an arbitration statute authorizing persons to agree in writing to the submission of controversies to arbitration. (Kahle-Fla)
W69-02629

CHAPTERS 13-14: TRIAL COURT ACTIVITY; FEDERAL MATTERS,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
Fred Mann, Harold Ellis, and N. G. P. Krausz.
Water-Use Law in Illinois, pp 228-257, 1964. 30 p, 1 fig. (For main entry see W69-02624).

Descriptors: *Illinois, Adjudication procedure, Consumptive use, *Federal jurisdiction, Federal government, Water rights, Project purposes, *Legal aspects, *Administrative agencies.

Chapter 13 is a two page report on trial court activity in Illinois involving water-use conflicts between 1956 and 1959. Questionnaires revealed few water-use cases. Of nine decided cases in 1956, six involved pollution, and none involved consumptive use conflicts. Only one case of significance involving consumptive use had arisen when the second set of questionnaires was sent out in 1959. Chapter 14 discusses federal regulations and programs that may have a bearing on Illinois water rights. The primary source of federal jurisdiction regarding water resources is the commerce clause of the United States Constitution. Responsibilities and jurisdiction of the U S Army Corps of Engineers, as well as the Federal Power Commission, the Coast Guard, the Dept of Health, Education and Welfare, the Dept of Agriculture, the Dept of the Interior, and the Dept of Commerce, are discussed in detail. (Kahle-Fla)
W69-02630

CHAPTER 15: INTERSTATE AND INTERNATIONAL MATTERS,
Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.
Fred Mann, Harold Ellis, and N. G. P. Krausz.
In Water-Use Law in Illinois, pp 257-283, 1964. 27 p. (For main entry see W69-02624).

Descriptors: *Illinois, International law, *Equitable apportionment, *Interstate compacts, International waters, Interstate rivers, State jurisdiction, Federal jurisdiction, Great Lakes, Ohio River, Lake Michigan, Pollution, *Water law, Legal aspects.
Identifiers: FWPCA.

Interstate and international matters involving water rights are discussed. The United States Supreme Court has exclusive and original jurisdiction in cases where states are parties. The Court may apply principles derived from international law, and has built an independent doctrine of interstate law known as the doctrine of equitable apportionment of benefits. Two or more states with interests in a body of water may control its use by interstate compact, subject to the consent of Congress. The Great Lakes Basin Compact and the Ohio River Valley Water Sanitation Compact are discussed. Special problems concerning Lake Michigan are also discussed. Illinois holds title to the bed of Lake Michigan within its boundaries in trust for the people of the state. The Federal Water Pollution Control Act authorizes the federal government to abate pollution of interstate waters under supervision of the Secretary of Health, Education, and Welfare. The Supreme Court also has jurisdiction over interstate pollution cases, although interstate compact has been a more feasible method of dispute settlement. The significance of the Northwest Ordinance of 1787 as an element of federal law regarding federal jurisdiction and interstate matters is largely an open question under present court decisions. (Kahle-Fla)
W69-02631

RIVERS AND CREEKS - DRAWS IN BRIDGES ON NON-NAVIGABLE STREAM.

N C Gen Stat sec 77-10 (1967).

Descriptors: *North Carolina, Legislation, *Bridges, Boats, Rivers, Streams, *Navigation, Administrative agencies, Navigable rivers, Navigable waters, *Non-navigable waters, Roads, Highways.
Identifiers: Draws.

Whenever the navigation of any river or creek which, in the strict construction of law, might not be considered a navigable stream, is obstructed by any bridge across the stream, except those under the supervision and control of the State Highway Commission, it is lawful for any person owning any boat plying on the stream to make a draw in the bridge sufficient for the passage of his boat. The owner of the boat must construct and maintain the draw at his own expense, and must use the draw in such a manner as to delay travel over the bridge as little as possible. (Watson-Fla)
W69-02632

OBSTRUCTING NAVIGABLE WATERS.

N C Gen Stat secs 76-40--43 (1964).

Descriptors: *North Carolina, *Legislation, Administrative agencies, Boats, Ships, Navigable waters, Navigable rivers, Rivers, Channels, *Navigation, Bays, United States, *Lighthouses, Lumbering, Tributaries, Anchors.
Identifiers: *Obstruction to navigation, Beacons.

If any person throws any substance likely to be injurious to navigation into any navigable waters of the State of North Carolina, or willfully pulls down any beacon, stake, or other mark erected by the commissioners of navigation, he is guilty of a misdemeanor and must pay $200 to the commissioners in whose waters the offense was committed. If any pilot knowingly allows any such unlawful act to be done, and does not report it to the commissioners within ten days, he will likewise be guilty of a misdemeanor. Besides the usual punishment, upon conviction, a pilot will never be allowed to act as a pilot in the State. It is also unlawful to obstruct the waters of Currituck Sound, and all persons now obstructing the waters are required to remove the obstructions. All lumbermen are required to remove all obstructions placed by them in the waters of Albemarle Sound, as soon as practical, after their initial purposes are fulfilled. If the master of any vessel anchors on the range line of any range of lights established by the United States lighthouse board, he will be guilty of a misdemeanor punishable by a fine not to exceed $50, unless the anchorage is unavoidable. (Watson-Fla)
W69-02634

HAFERKAMP V CITY OF ROCK HILL (ACTION FOR DAMAGES FROM COLLECTION AND DISCHARGE OF SURFACE WATERS).
For primary bibliographic entry see Field 04A.
For abstract, see .
W69-02636

ADAM HAT STORES V KANSAS CITY (ACTION FOR DAMAGES FROM BROKEN WATER LINE).

316 S W 2d 594-601 (Mo 1958).

Descriptors: *Missouri, Judicial decisions, *Cities, Pipes, Damages, *Overflow, *Conduits, Legal aspects, Water law.
Identifiers: Negligence, Res ipsa loquitur.

Plaintiff brought this action against the city for damages to the plaintiffs merchandise resulting from a break in the city's water main. The verdict was for the city, but the trial judge granted a new trial because of an error in refusing to permit the plaintiff's attorney to call as witnesses two of its employees who were at the scene of the broken main shortly after it was discovered. The city appealed the granting of the new trial and also argued that no submissible case of the city's negligence was made under the res ipsa loquitur doctrine (the thing speaks for itself). Both rulings of the trial court were affirmed by the Supreme Court of Missouri, thus giving the plaintiff a new trial. The doctrine of res ipsa loquitur applied to city waterworks because: (1) the water mains were installed and maintained under the exclusive control of the city; (2) evidence showed that the breaking of a water main is an occurence that does not ordinarily happen if those in charge use due care; (3) the cause of the break was unknown to the plaintiff; and (4) the city had superior knowledge or means of information to ascertain the cause. (Watson-Fla)
W69-02637

PEOPLE V KRAEMER (ANCHORAGE OF VESSELS).

177 NYS 2d 425-429 (Suffolk County Ct 1958).

Descriptors: *New York, Admiralty, Boundaries (Property), Judicial decisions, Public rights, Beds, *Navigable waters, Ownership of beds, Navigation, *Harbors, Ships, Shores, *Intertidal areas.
Identifiers: Trespassing, Trespass, Criminal trespass.

Defendants were charged with violation of a village ordinance proscribing trespassing in that defendants anchored their vessels upon plaintiff's submerged property in a navigable harbor and that one of the defendants entered upon the foreshore. The court found that, considering the navigable condition of the waters of the harbor, the temporary anchorage of boats constituted no crime. Only the defendant who intruded upon the foreshore had criminally trespassed. (Scott-Fla)
W69-02641

JURISDICTION OVER NAVIGABLE STREAMS.

Ala Code tit 12, sec 175 (1958).

Descriptors: *Alabama, *Legislation, Streams, Jurisdiction, *State jurisdiction, Legal aspects, State governments, Boundaries (Property), Riparian rights, *Navigable waters.

Jurisdiction over navigable streams not within any county's limits belongs to the county or counties whose jurisdiction extends to the margin thereof and officers of either county may execute all process on such streams. (Geraghty-Fla)
W69-02642

CORPORATIONS - POWER, RIGHTS, DUTIES (CONDEMNATION POWER OF WATER WORKS AND OTHER PUBLIC UTILITIES).
Ala Code tit 10, sec 75-80 (1958).

Descriptors: *Alabama, *Legislation, *Condemnation, Easements, Legal aspects, Water supply, *Water works, Riparian rights, Cities, Rivers, Streams, Springs, Ponding, Water storage, Reservoirs, Public utilities, Right-of-way, Pipes.

Alabama, by statute, permits companies formed for the purpose of constructing, operating or maintaining any internal improvement or public utility to acquire right-of-way land by condemnation. Additionally, waterworks companies may condemn the water of any river, stream, spring or other water source to obtain a supply of water for their storage ponds, reservoirs, pipes and canals. In order to protect and preserve the purity of such supply, these companies may also acquire, through condemnation, riparian rights and all necessary adjacent lands to such watercourses. These ad quod damnum proceedings are to be instituted against the riparian land owner in the probate court of the county in which such lands are situated, in accordance with general state law providing for the condemnation of land for public purposes. However, no water company shall condemn a water source which is the property of another water company supplying a city or town with water. (Geraghty-Fla)
W69-02643

SOVEREIGNTY AND OWNERSHIP OF WATERS WITHIN STATE BOUNDARIES.
La Rev Stat secs 49:2-6 (1965).

Descriptors: *Louisiana, Legislation, United States, *Ownership of beds, Gulf of Mexico, *Boundaries, Mississippi, State jurisdiction, Local governments, Ownership of beds.
Identifiers: Sovereignty, State ownership of waters.

Subject to the rights of the United States, the state of Louisiana has full sovereignty over the beds, shores, and all waters of the Gulf of Mexico within the boundaries of Louisiana. These waters, beds and shores are owned by the state of Louisiana. The water boundary between Louisiana and Mississippi from the mouth of the Pearl River to the Gulf of Mexico is fixed by decree of the Supreme Court of the United States and is marked and buoyed so as to be reasonably permanent and apparent. The gulfward boundaries of all coastal parishes are described. (Childs-Fla)
W69-02644

MINERALS, OIL, AND GAS.

La R S 1965 30:124, 172.

Descriptors: *Louisiana, *Leases, State governments, Navigable waters, Navigable rivers, Breakwaters, Landfills, *Mineral industry, *Legislation, Public lands, Landfill, Permits, Beds.
Identifiers: Mineral rights, Mineral leases.

The state mineral board may grant mineral leases on any state lands, including water bottoms. Any such lessee is permitted to build and control breakwaters, platforms, fills, islands, and any other facilities necessary or convenient for the production or marketing of minerals produced under such lease. A permit must be obtained before an island or fill is made within navigable waters. (Scott-Fla)
W69-02646

SERVITUDES; RIGHT OF PASSAGE AND OF WAY.

La Civil Code Arts 707, 711, 714, 720, 721, 723.

Descriptors: *Louisiana, Right-of-way, Rural sociology, State governments, Well permits, *Roads, Drains, Drainage, Pipes, Canals, Wells, Springs, *Public rights, *Legislation.
Identifiers: Servitudes.

Any landowner who is obligated to provide a public road along a river or stream must furnish another without compensation if the first becomes impassable or is washed away. Principal types of urban servitudes are listed. The right of drain consists in the servitude of passing water collected in pipes or canals through the land of one's neighbor. The right of drawing water, usually confined to those living in the house of the person enjoying the servitude, is a servitude by which one permits his neighbor to draw water from a well or spring he has on his property. Principal types of rural servitudes are listed. (Scott-Fla)
W69-02647

LIMITATIONS: PUBLIC DEBT, LANDS, ETC.

La Const Art 4, Para 2.

Descriptors: *Louisiana, *Leases, *Ownership of beds, Riparian waters, State governments, Navigable waters, Navigable rivers, Land reclamation, Reclamation, *Royalties, Mineral industry, Highways, Bridges, Roads.
Identifiers: Mineral rights, Mineral leases.

The state legislature may not alienate, or authorize the alienation of, the ownership of any bed of a navigable stream, lake, or other body of water except for the purpose of reclamation. The mineral rights on such beds sold by the state shall be reserved, except where the property is redeemed by one who has lost the property for non-payment of taxes. The legislature is not, however, prohibited from leasing such lands for mineral or other purposes. From all mineral leases granted by the state or state-owned land, lake and river beds and other state-owned water bottoms, ten per cent of royalties received from such leases shall be placed in a special fund for the credit of the parish from which the production is had, to be used exclusively for building and maintaining roads, highways, bridges, tunnels and ferries in said parish. (Scott-Fla)
W69-02648

SHAFFER V BAYLOR'S LAKE ASSOCIATION (PRESCRIPTIVE RIGHTS TO USE OF A LAKE).

392 Pa 493, 141 A 2d 583-587 (1958).

Descriptors: *Pennsylvania, Easements, Judicial decisions, Riparian rights, *Prescriptive rights, *Non-navigable waters, Lakes, *Ownership of beds, Boating, Fishing.

Plaintiff owned an individed majority interest in a piece of land abutting on a non-navigable lake. For fifty years the family of plaintiff had used the lake for swimming, boating, fishing, etc. Plaintiff's family had held title to the lake bottom. When defendant purchased the lake, plaintiff's right to the use of the lake was challenged. Plaintiff brought suit to quiet title to use of the lake, claiming rights to fishing, boating, swimming and commercial or rental boating. The jury found for the plaintiff, but judgment notwithstanding the verdict was entered for defendant. Plaintiff appealed to the Supreme Court of Pennsylvania which reversed. The court held that plaintiff had established prescriptive rights to swim, boat, fish, maintain her present dock, and water her cattle, but not to commercial boating or any commercial use of the lake. The court stated that riparian rights do not attach to lands abutting on non-navigable lakes, where the lake bottom is owned by others. Invasion of the water under such circumstances is trespass. However, plaintiff had showed open and continuous use of the lake for the non-commercial purposes enumerated, and the court held that it had gained these rights by prescription. (Williams-Fla)
W69-02649

GRAND RIVER DAM AUTHORITY V UNITED STATES (COMPENSATION FOR STATE WATER RIGHTS).
153 F Supp 153-159 (1959).

Descriptors: *Oklahoma, *United States, Judicial decisions, *Federal-state water rights conflicts, Administrative decisions, Navigable waters, Non-navigable waters, Dams, Reservoirs, Eminent domain, Legal aspects, Compensation, Tributaries, Flood control, Beds, Hydroelectric power, Hydroelectric plants, Highwater mark, Water courses (Legal).
Identifiers: Arid states doctrine, Flood Control Act, Fast lands.

An agency of the state of Oklahoma was empowered to build 3 dams. One was completed and land, easements, and rights-of-way for the others had been obtained. Congress then passed the Flood Control Act and authorized construction of dams on these same sites. One of these dams was completed by the federal government. The state agency sued the United States for the taking of its property, seeking compensation for its water power rights, its exclusive franchise to develop electric power, and certain items of severance damage. The state right to control non-navigable waters is subordinate to the right of the United States to control such waters for purposes of control of navigable waters. But, if, in the exercise of this right, private property on a non-navigable stream is taken, the United States must pay just compensation. The items of severance damages were not property rights and were not compensable. (Childs-Fla)
W69-02652

VARTELAS V WATER RESOURCES COMMISSION (ESTABLISHMENT OF ENCROACHMENT LINE).

146 Conn 650, 153 A 2d 822-826 (1959).

Descriptors: *Connecticut, Administrative decisions, Eminent domain, Judicial decisions, Legislation, *Permits, Public benefits, State governments, Water resources development, *Regulation, Zoning, Water zoning, Building codes, Control, Banks, *Flood control, Flood protection, Flood damage, Floods, Rivers.
Identifiers: Naugatuck River.

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A water resources commission established, along the bank of a river, a line beyond which, in the direction of the river, no structure or encroachment could be placed without its permission. Plaintiff's land was affected by the commission's action, and he appealed, claiming that the establishment of the line constituted an unconstitutional taking of the property for a public use without compensation. The purpose of the act under which the commission acted was to enable the commission to forestall, by stream clearance, channel improvement, and other flood control measures, the recurrence of recent serious flood damage. This was held to be a valid exercise of the police power of the state. The police power regulates use of property because uncontrolled use would be harmful to the public interest. Eminent domain, on the other hand, takes private property because it is useful to the public. The court held that the commission did not abuse its powers in proceeding by way of regulation rather than by way of eminent domain. The commission's refusal to permit plaintiff to erect a building within the encroachment line was, under the circumstances, justified. (Scott-Fla)
W69-02653

BEVELANDER V TOWN OF ISLIP (POWER TO LEASE BAY FLOOR FOR SHELLFISHING).

185 NYS 2d 508-511 (1959).

Descriptors: *New York, Judicial decisions, Legislation, Bays, *Shellfish, *Commercial fishing, Navigable waters, *Ownership of beds, Land tenure, Public rights, Legal aspects.

A taxpayer sought to annul a lease by the town granting lessee use of bottom of a certain bay for planting and cultivating shellfish. The title to lands under water passed to the states after the revolution. The only limitation on grants of these lands by the legislature was that they not be in derogation of public rights. The right to plant, grow, and own shellfish in navigable waters was never considered to be an appropriation in derogation of public rights. Hence there is no inherent disability in the state of New York to convey the bay floor to a town. Such a conveyance rests in the town the right to lease the bay floor for shellfishing purposes. (Childs-Fla)
W69-02655

LAKESIDE PARK CO V FORSMARK (NON-NAVIGABLE PONDS).
396 Pa 389, 153 A 2d 486-490 (1959).

Descriptors: *Pennsylvania, Judicial decisions, Ownership of beds, Public rights, Relative rights, *Navigable waters, Bodies of water, Surface waters, Navigation, *Non-navigable waters, Ponds, *Lakes, Standing waters, Great ponds, Reasonable use, Recreation, Legal aspects.
Identifiers: Sandy Lake.

Defendant wanted to make commercial use of his lakeshore property, which he was allowed to do if the lake was navigable and public, but which he could not do if it was non-navigable and private. Plaintiff sued to enjoin such use, asserting that the lake was non-navigable. The lake, 5,070 feet long and 1,930 feet wide at its widest point, formerly had been used as a resort area and was serviced by a railroad which made trips around the lake. Plaintiff, who owned most of the bed, operated summer cottages on its own property. Defendant's whole case for navigability rested on the past uses of the lake. The court stated that the concept of navigability should depend upon whether the water was used or usable as a broad highroad for commerce and the transport, in quantity, of goods and people, (the rule naturally applicable to rivers and to large lakes) or whether the water remained a local focus of attraction. (The rule applicable to shallow streams and small lakes and ponds). The basic difference is that between a trade route and a point of interest; the first is a public use, while the second private. The court found that the lake in question was a small lake or pond and not navigable. (Scott-Fla)
W69-02656

BRADLEY V COUNTY OF JACKSON (RIPARIAN RIGHTS IN ARTIFICIAL LAKE).

347 S W 2d 683-691 (Mo 1961).

Descriptors: *Missouri, Judicial decisions, *Right-of-way, Easements, Riparian land, *Riparian rights, Recreation, Lakes, Developed waters, Public rights, Water law, Artificial watercourses, Fishing, Domestic water, Boating, Swimming.
Identifiers: *Artificial lakes.

This action was brought by several landowners surrounding an artifically created lake, against the county for a declaration that the plaintiffs possess riparian rights in the lake. The trial decisions was for the plaintiffs and the county appealed. The Supreme Court of Missouri reversed the decision and remanded the case to the lower court with directions as to ascertaining the rights of all parties. When the original owners granted land to the county to create the lake, reserving to themselves and their grantees the right to use the lake for appropriate purposes, those who took, directly or indirectly, from those grantors, land on the shoreline of the lake, acquired the riparian privileges of the original owners. These rights could be conveyed either by express grant, if stated in the deeds, or by implication. Riparian rights come from ownership of land abutting the water, and arise as incidents of ownership of upland soil, regardless of ownership of submerged land. Riparian rights of appropriate purpose include swimming, boating, fishing and taking water for domestic purposes. (Blunt-Fla)
W69-02658

NUGENT V VALLONE (PIERS).

161 A 2d 802-806 (1960).

Descriptors: *Rhode Island, *Legislation, *Piers, *Riparian rights, Riparian land, Water law, Navigable waters, Ownership of beds, Beds under water, Legal aspects, Boundaries (Property), Coastal structures, Public benefits, Bays, Navigation, Fishing, Public lands, Judicial decisions.
Identifiers: *Narragansett Bay.

This action concerns the possible violation of public rights in the public waters of the state by the construction of a proposed pier. It was contended that the pier would be an interference with navigation and would constitute an unlawful appropriation of the public domain under the waters. The court held that the evidence indicated that respondent corporation was the owner of the entire east shore directly opposite the proposed pier and, as the sole riparian owner thereof, had the right to wharf out into the east passage in order to obtain the full advantages of navigation. It is true that the state holds title to the soil under the public water of the state. However, the state holds such title merely as trustee for the public in order to preserve its rights of fishery, navigation and commerce in such waters. The duly constituted public authorities had certified that the proposed pier would not interfere with any of those public rights. The court denied the appeal and affirmed the decision of the lower court. (Smith-Fla)
W69-02660

UNITED STATES V REPUBLIC STEEL CORP (RIVERS AND HARBORS ACT).

362 U S 482-488 (1960).

Descriptors: *Judicial decisions, *Rivers and Harbors Act, Federal government, Obstruction to flow, *Industrial wastes, *Navigable waters, Beds, Legislation, Administrative agencies, Navigation, Rivers, Depth.

The United States, petitioner, brought suit against respondents to enjoin them from depositing industrial solids into the Calumet River and to direct them to restore the depth of the channel. The U S alleged that respondents' activities violated sec 10 of the Rivers and Harbors Act by creating an obstruction to the navigable capacity of a river which did not come within the exception for refuse flowing from streets and sewers in a liquid state. The evidence showed respondents' took water from the river for use in their operations and returned it containing solids in suspension that eventually settled to the river bottom. The depth of the river was significantly reduced around respondents' industrial sites. The District Court found for petitioner and the Court of Appeals reversed. On certiorari, the Supreme Court held that respondents' activities constituted an obstruction as contemplated by the Act, the exception provided in the Act extending only to sewage. The Court granted the injunctive relief asked. Four justices dissented at length on the grounds that respondents' activities were not proscribed by the Act. (Williams-Fla)
W69-02662

AN ACT AUTHORIZING THE STATE OF MISSOURI TO MAKE GRANTS... TO PAY... THE COSTS OF WATER POLLUTION CONTROL PROJECTS WHICH QUALIFY... UNDER THE FEDERAL WATER POLLUTION CONTROL ACT.
Missouri Laws ch S 396 (1967).

Descriptors: *Missouri, *Legislation, Public utility districts, *Sewage districts, *Government supports, Sewers, Sewage treatment, Government finance, Government finance (Taxes), Planning, *Cost sharing, Cost allocation, Water pollution control, Sewage disposal, Operation and maintenance.
Identifiers: FWPCA.

The state is authorized to make grants to its political subdivisions qualifying for Federal aid for purposes of constructing water pollution control projects. The act provides for federal-state cooperation and makes funds available to such projects on the basis of relative need and priority. The aim of the act is to encourage the construction and maintenance of common sewer systems and treatment plants. The citizens of the proposed project areas must approve, by referendum, any application for consolidated sewage districts. Sewage districts, when approved, may be either single or multi-county. The districts shall be considered a distinct, corporate and political body, and it shall possess all the rights and liabilities accruing to such entities. District boards shall have the power to determine where and what types of wastes may lawfully be discharged into the facilities of the district. Drainage districts may be supported via issuance of revenue bonds by constituent municipalities. If, after the sewer system is constructed, the voters defeat proposals for the issuance of bonds, the system may be financed via levying of special real property taxes. Under the act, each district board may apply for and accept state and/or federal funds and grants to defray the local construction costs of sewer systems. (Blunt-Fla)
W69-02663

WATERCOURSE MADE LAWFUL FENCE BY COUNTY COMMISSIONERS.

N C Gen Stat sec 68-3 (1964).

Descriptors: North Carolina, Legislation, Legal aspects, Local governments, Watercourses.
Identifiers: Fences.

This section provides the procedures whereby any watercourse may be made a lawful fence. (Childs-Florida)
W69-02701

PROTECTION OF SAND DUNES ALONG OUTER BANKS.

N C Gen Stat sec 104B-3--13 (1967 Supp).

Descriptors: *North Carolina, Legislation, Administrative agencies, Regulation, Local governments, Hurricanes, Storms, *Dunes, Atlantic Ocean, Southeast U S, Banks, *Barriers, *Erosion, Public health, Beaches, Legal aspects, Beach erosion, State governments, Permits.
Identifiers: Shoreline Protection Officer.

The legislature has deemed it necessary to protect the system of protective dunes along the Atlantic Ocean. This act makes it unlawful to damage or remove any sand dune lying along the outer banks or to destroy or remove any vegetation growing on said dunes without first having obtained a permit. Any county may establish a shore protection line whereby the provisions of this subsection will only apply to the ocean side of said protection line. No permit will be issued unless it is found that the dune will not be materially weakened or reduced in effectiveness. The act provides the method for appointment of a Shoreline Protection Officer. The duties of the Shoreline Protection Officer are provided. The Board of County Commissioners is empowered to adopt regulations necessary to enforce this act. The Commissioners are also authorized to levy a tax to pay the expenses in carrying out this act. Provision is made for the appeal and review of any decision by a Shoreline Protection Officer. The Department of Water Resources shall establish a project protection line along which beach restoration or hurricane protection projects will be constructed. No construction on the ocean side of the project protection line is allowed. Provision is made for punishing violations of any part of this act. (Childs-Florida)
W69-02702

INLAND WATERWAYS.

N C Gen Stat 104-12--25 (1964).

Descriptors: *North Carolina, *United States, Legislation, Administrative agencies, Regulation, *Inland waterways, *Right-of-way, Real property, Marshes, Beds, Condemnation, Eminent domain, Damages.
Identifiers: Cape Fear River, Beaufort Inlet.

To aid in the construction of the Inland Waterway by the United States from the Cape Fear River to the North Carolina-South Carolina state line, the Secretary of State is authorized to grant the land within the Inland Waterway right of way. If title to any land within the right of way is not in the state, then the state is authorized to condemn the land with the special benefits to the owner being offset against the damage to such lands. The state shall have the right to immediate possession of any such lands condemned. If determined to be necessary, the United States shall have the right to condemn land. North Carolina shall have concurrent jurisdiction over all lands held pursuant to this act. The act also provides for similar grants by the state and condemnation proceedings of land within the waterway right of way from Beaufort Inlet to the Cape Fear River. (Childs-Florida)
W69-02708

ACQUISITION OF LANDS FOR RIVER AND HARBOR IMPROVEMENT.

N C Gen Stat sec 104-6 (1964).

Descriptors: *North Carolina, United States, Legislation, Legal aspects, Rivers, Harbors, Navigation, *Condemnation, Locks, Dams, *Federal jurisdiction, *State jurisdiction, Eminent domain.

The legislature has authorized the United States to acquire land by purchase or condemnation for use as sites for locks and dams or for any other purpose connected with the improvement of rivers and harbors within the State. The State retains concurrent jurisdiction with the United States over lands acquired pursuant to this act. (Childs-Florida)
W69-02709

RECREATIONAL USE OF STATE LAKES REGULATED - FORFEITURE FOR FAILURE TO REGISTER DEEDS.
N C Gen Stat secs 146-18, 146-20 (1964).

Descriptors: *North Carolina, *Legislation, Lakes, *Recreation, Hunting, Fishing, Grants, Administrative agencies, *Swamps, Regulation, Surveys, Legal aspects.
Identifiers: Deeds, Escheat.

All recreation, except hunting and fishing, in, upon, or above all the lakes in North Carolina may be regulated in the public interest by the state agency having authority over these areas. All the grants and deeds of swamp lands made prior to November 1, 1883, must have been proved and registered in the county where the lands are situated within 12 months from November 1, 1883. Every such grant or deed not registered in that time is void, and the title of the proprietor in such lands shall be deemed to have reverted to the state. The above provisions are applicable only to the swamp lands which have been surveyed or taken possession of by, or are vested in, the state or its agencies. (Watson-Florida)
W69-02711

WISCONSIN POWER AND LIGHT CO V PUBLIC SERVICE COMMISSION (VALIDITY OF ORDER TO OWNER OF DAM).

5 Wis 2d 167, 92 N W 2d 241-247 (1958).

Descriptors: *Wisconsin, Judicial decisions, *Dams, Rivers Administrative agencies, State jurisdiction, *Regulation, *Flow rates, Riparian rights, Legislation, Flow measurement, Hydroelectric plants, Water law.
Identifiers: Police power, Minimum flow.

The Wisconsin Public Service Commission issued an order to the Wisconsin Power and Light Co to maintain one of its dams in such a way as to provide a specified minimum flow in the river. The order was given after petition by riparian owners and others to the Public Service Commission, and a public hearing. The power company contended that the commission did not have the authority to issue such an order. On appeal to the Wisconsin supreme court, the order was upheld. The court pointed out a provision in the act allowing the power company's predecessor to build the dam, which reserved the right to amend the act. This refuted the company's contention that to limit its use of the dam impaired an obligation of contract. The court further stated that it was within the state's police power to protect public rights in navigable waters, by regulation of the company's operation of the dam. The federal government had not issued any regulations applying to this river. The court also held that the taxpayers and riparian owners had standing to petition the commission for this order. (Williams-Florida)
W69-02712

VMJ COMPANY V CITY OF LORAIN (EXTENT OF MUNICIPAL SEWAGE AND WATER SERVICE).

151 N E 2d 667-672 (Ohio Ct App 1957).

Descriptors: *Ohio, Judicial decisions, *Cities, *Utilities, Sewage disposal, Sewers, Water supply, Plumbing, Water delivery, Legal aspects.
Identifiers: City limits.

Plaintiff brought suit for declaratory judgment contending that it was a bona fide inhabitant of the city of Lorain and that the city would have to provide the shopping center which it owned with water and sewage tap-ins. The shopping center was partially within and partially without the city limits. The city was authorized by the Ohio Constitution to enact legislation extending utility service beyond the city limits, but as yet, it had not done so. The company maintained that since part of its building was within the limits, service should be provided for the entire building. On appeal, it was held that the Company would have been entitled to service if it had wholly occupied the building. However, much of the part of the building outside the city limits was to be rented or leased to other parties. Therefore, the company could not compel the city to provide service for the entire building because those renting the part of the shopping center outside the city limits were not inhabitants of the city. (Williams-Fla)
W69-02713

THURLOW V TOWN OF PROVINCETOWN (MAINTENANCE OF CITY WATER SYSTEM).

149 NE 2d 901-905 (Mass 1958).

Descriptors: *Massachusetts, Judicial decisions, *Cities, Water supply, *Water works, Local governments, *Metal pipes, Conduits, Freezing, Damages, Municipal water.

Plaintiff brought suit against the city to recover for damage to his house caused by fire. Plaintiff alleged that the fire was caused by the city's negligence in allowing electricity to escape into his house while a welding machine was being used to thaw out the defendant's underground water system. On appeal, the Supreme Judicial Court of Massachusetts held that although a city is liable for its negligence in the operation of a water system, the evidence in this case was not sufficient to establish a master-servant relationship between the city and the independent welding contractor who did the work in this case, thereby imputing his negligence to the city. (Williams-Fla)
W69-02714

STATE V MARTIN (CONSTITUTIONALITY OF STATUTE REQUIRING WELL DRILLERS TO SUBMIT LOGS).
152 N E 2d 898-905 (Ohio Ct App 1957).

Descriptors: *Ohio, Judicial decisions, *Legislation, *Wells, Drilling, Groundwater, Well regulations, Administrative agencies, Regulation, *Logging (Recording), Legal aspects, Conservation, Natural resources.
Identifiers: Police power, Constitutional objections.

Defendant was charged with violation of a statute requiring persons who drilled wells for hire to file logs with the Division of Water of the Department of Natural Resources. Defendant claimed that the statute was unconstitutional on two grounds: (1) that it denied him equal protection of the laws in that it applied only to those who drilled wells for hire, and (2) that, by requiring him to provide valuable information, it deprived him of property without due process of law. The state appealed from two adverse rulings. The Ohio Court of Appeals reversed, holding that statute constitutional. The court said that the police power of the state encompasses the power to legislate for the protection of natural resources. A statute establishing as a class those who drill wells for hire is not unreasonable and arbitrary because it applies only to that class and does not violate the state constitutional requirement that laws be uniform of application. The Constitution of Ohio specifically grants to the legislature the power to pass laws for the protection of natural resources. The court further held the statute did not deprive defendant of property without due process of law. (Williams-Fla)
W69-02716

LIBRARY U. OF I. URBANA-CHAMPAIGN

WOODSIDE HOMES, INC V TOWN OF MORRISTOWN (COSTS OF EXTENSION OF WATER MAINS).

26 N J 529, 141 A 2d 8-17 (1958).

Descriptors: *New Jersey, Judicial decisions, Administrative agencies, *Administrative decisions, Cities, Conduits, *Pipelines, *Costs, Financing.
Identifiers: Primary jurisdiction doctrine, Prior resort doctrine, Estoppel.

Appellant construction company brought suit against respondent city based on an agreement entered into by the parties, whereby the city extended its water mains to supply appellant's real estate development. The cost of such extension was borne by appellant. Its complaint contained two counts: the first sounded in tort and alleged a violation of the city's public duty to extend its mains at its own expense; the second was an action in quasi contract based on unjust enrichment in that the city obtained valuable property at appellant's expense. At trial the court held that the agreements were voluntary and binding and dismissed the complaint. On appeal, the Supreme Court affirmed. The court stated that in order for the developer to recover his expenses for extension of the mains, he must show either a violation of an absolute statutory duty or an abuse of discretion by the city. The court also stated that the decision as to whether an extension of mains will be ordered lies with the Board of Public Utility Commissioners in the first instance. This was the doctrine of 'primary jurisdiction' or 'prior resort,' and such doctrine precluded a judicial determination until the agency had ruled. However, the court did not remand the case to the Board because it held that by its actions in contracting with respondent, the appellant was estopped to deny the efficacy of the agreements. (Williams-Fla)
W69-02718

OBSTRUCTING NAVIGATION AND DAMS STATUTE.

Ala Code tit 38, secs 104-122 (1958).

Descriptors: *Alabama, Control, Navigation, Stream improvement, Easements, Eminent domain, Legal aspects, Water law, Permits, Prescriptive rights, Riparian rights, *Navigable waters, Navigable rivers, Obstruction to flow, Barriers, Docks, *Dams, Dam construction, State jurisdiction, Federal jurisdiction, Docks.

A definition of navigable streams is set out. Fines for obstructing streams used for floating timber, and for obstructing all other navigable watercourses are provided. Other specific acts relating to obstructing navigable streams are listed and expressly prohibited with fines for violation being provided. Firms organized for the purpose of improving navigation on a navigable river are given specific rights to construct dams and to obtain easements provided that plans are approved as prescribed. The provisions of the statute relating to improvement of navigation are made retroactive. Rights of riparian owners to build wharves, docks and the like are maintained so long as state and national standards are complied with. It is provided that any tolls charged for the use of these wharves are subject to control by the state. (Pfeiffer-Fla)
W69-02719

TOMBIGBEE-TENNESSEE WATERWAY DEVELOPMENT COMPACT.
Ala Code tit 38, secs 123-126 (1958).

Descriptors: Federal jurisdiction, *Interstate compacts, *Alabama, Mississippi, Interstate, State jurisdiction, Administrative agencies, *Tennessee River, State governments, Inter-basin transfers, *Interstate commissions, Rivers, Legal aspects, Water resources development, Water law, Interstate rivers, Expenditures, Financing.

The Governor of Alabama is herein authorized to execute a compact with the State of Mississippi in substantially the form set out. The expressed purpose of the compact is to promote the development of a navigable waterway connecting the Tennessee and Tombigbee Rivers. The Tennessee-Tombigbee Waterway Development Authority is provided for, and the authority's organization, duties and powers are prescribed. An appropriation is made to effectuate the statute's provisions. Procedure for admitting other states to the compact is set out. The governor of each member state and five other appointive member from each state compose the membership of the authority. The authority is empowered to acquire land to effectuate its functions, and to promulgate its own rules. The compact is to become effective when ratified by the member states and approved by Congress. (Pfeiffer-Fla)
W69-02720

CHANGE IN OWNERSHIP OF LAND OR WATER BOTTOMS.
La R S 9:1151 (1965).

Descriptors: *Louisiana, Legislation, Land tenure, Stream beds, Navigable waters, *Ownership of beds, *Royalties, *Leases, Legal aspects, Accretion.
Identifiers: *Mineral rights.

Where a change in the ownership of land or water bottoms occurs as a result of the action of a navigable body of water or as a result of accretion, dereliction, or other condition, the new owner shall take the same subject to, and encumbered with, any oil, gas, or mineral lease affecting such lands and subject to the mineral and royalty rights of the lessors in such lease. (Childs-Fla)
W69-02727

BATTURE IN CITIES AND TOWNS - RIGHTS OF RIPARIAN OWNER.

La R S 9:1102 (1965).

Descriptors: *Louisiana, Legislation, Local governments, *Riparian rights, *Accretion, Beds, *Ownership of beds, Legal aspects.

When the riparian owner in any incorporated town or city is entitled to the right of accretion, and more batture has been formed than is necessary for public use, he shall have the right to institute an action for the batture not needed for the public use. (Childs-Fla)
W69-02728

OWNERSHIP OF WATERS AND BEDS.
La R S 9:1101 (1965).

Descriptors: *Louisiana, Legislation, *Ownership of beds, *Navigable waters, *Water bodies, Bayous, Rivers, Streams, Lagoons, Lakes, Bays, Beds, Domestic waters, Cities.

The waters and beds of all bayous, rivers, streams, lakes, and bays not under the direct ownership of any person on August 12, 1910, are declared to be property of the state. No charge shall be assessed against any person for the use of these waters for municipal, industrial, agricultural, or domestic purposes. All transfers to any levee district by the state of any navigable waters and the beds and bottoms thereof are void. (Childs-Fla)
W69-02729

RIVER DEVELOPMENT CORP V LIBERTY CORPORATION (RIGHT TO IMPROVE SUBMERGED TIDELANDS).
51 N J Super 447, 144 A 2d 180-199 (1958).

Descriptors: *New Jersey, Judicial decisions, *Tidal waters, Reclamation, *Land reclamation, Dredging, Beds, Legislation, *Permits, State governments, Navigable waters, Riparian rights, Riparian waters, Grants, High water mark, Rivers, Shores, Railroads, Docks.
Identifiers: Tidelands.

Plaintiff's predecessors in title were granted permission by virtue of a special legislative act to improve lands under tidal waters. When defendant began certain dredging operations in the tidal waters of the river mentioned in the above act, plaintiff sued to enjoin the defendant from continuing the dredging, and for a declaration of rights of the plaintiff corporation in and to such subaqueous tidal lands. The court held that the special legislative act enabling the plaintiff to reclaim tide-flowed lands and erect wharves and other permanent improvements created a revocable license rather than a grant, and that the failure to exercise the rights granted under such licenses at the location in question for over eighty-six years constituted an abandonment of those rights. Also, plaintiff's predecessor in title could not validly transfer the right to improve subaqueous lands separate from the upland, as was done here, until after the right to reclaim had been exercised. (Scott-Fla)
W69-02733

YARA ENGINEERING CORP V N J TURNPIKE AUTHORITY (OWNERSHIP OF CREEK BED).

49 N J Super 603, 141 A 2d 66-68 (1958).

Descriptors: *New Jersey, Judicial decisions, *Ownership of beds, Beds, Streams, Streambeds, *Tidal waters, Tides, *Navigable waters, Fishing, Flow, Water rights, Non-navigable waters.

Plaintiff brought an action for declaratory judgment contending that title to a creek bed was good as against the defendant, who held title under a grant from the state. From a summary judgment entered by the Law Division in the defendant's favor, the plaintiff appealed. The Superior Court affirmed, holding that the State was the owner of land within the boundaries of a creek ordinarily flowed by tide water even if the creek was not a navigable stream or suitable for fishery. The test to be followed in New Jersey in determining the State's sovereignty over submerged lands is the tidal test only. (i e, whether the waters are affected by the ebb and flow of the tide). (Watson-Fla)
W69-02735

STATE V DAKOTA COUNTY (TITLE TO LAND BELOW HIGH WATER MARK).
93 NW 2d 595-600 (Iowa 1958).

Descriptors: *Iowa, Judicial decisions, Boundaries (Property), *Riparian waters, State government, Low water mark, *Ownership of beds, Watercourses (Legal), High water mark, *Navigable rivers, Navigable waters, Rivers, Riparian rights.

The State of Iowa filed a petition asking specific performance of a contract by defendants to convey a tract of land along a river to plaintiff. The land extended to the low water mark along the river. Defendants counterclaimed, and asked that title be quieted in them. The court held that land between the low water mark and the high water mark on a navigable stream belonged to the state as a matter of law. The state holds the title to soil below the high water mark in trust for navigation and commerce. (Scott-Fla)
W69-02736

CITY OF EUSTIS V FIRSTER (RIPARIAN RIGHT TO UNOBSTRUCTED VIEW).
113 So 2d 260-263 (2d DCA Fla 1959).

Descriptors: *Florida, Judicial decisions, *Citie Water law, *Navigable waters, *Riparian right Piers, Lakes, Legislation, Riparian land.

Plaintiff sought a mandatory injunction requiri the defendant city to remove certain structur which obstructed plaintiff's view of adjoini

waters. The court noted that a conveyance of uplands bounded by navigable waters carries with it riparian rights to the water. Under Florida law, the right of an upland owner to an unobstructed view of adjoining waters is a riparian right. However, plaintiff was barred by laches from suing for a mandatory injunction, 10 years having passed between acquisition of title and initiation of the suit. The structures complained of had existed 25 years when plaintiff bought his property. (Childs-Fla)
W69-02737

CARMAZI V BOARD OF COUNTY COMM'RS OF DADE COUNTY (RIPARIAN RIGHT OF ACCESS FOR NAVIGATION).
108 So 2d 318-324 (3d DCA Fla 1959).

Descriptors: *Florida, Judicial decisions, *Riparian rights, Damages, Dams, Navigable waters, Administrative agencies, United States, Legislation, Access, *Navigation, *Eminent domain, Flooding.
Identifiers: *Flood Control Act.

Appellant Carmazi brought suit to adjudicate property rights and recover for damage to his riparian land as a result of dam construction on a navigable stream. However, the court held that there was no showing of abuse of administrative discretion in selection of the site for the proposed dam. The right of navigation is common to the public in general and riparian owners acquire no additional rights to navigation other than those shared concurrently with the public. Eminent domain statutes protect only private rights. The proposed construction was justified as a necessary exercise of police power for the benefit of all, and the rights of those affected by exercise of such governmental function must give way to the benefits which accrue to the public as a whole. (Childs-Fla)
W69-02738

HARTFORD V TOWN OF GILMANTON (ACCESS ROAD TO PUBLIC LAKE).

146 A 2d 851-855 (N H 1958).

Descriptors: *New Hampshire, Boundaries (Property), *Easements, Judicial decisions, Leases, Local governments, Ownership of beds, Public rights, Recreation, *Shores, Right-of-way, *Roads, Access routes, Highways, Relative rights, Lakes, Ponds, Beaches, Lake shores, High water mark, Legal aspects, Eminent domain, Parks.
Identifiers: Loon pond.

Plaintiff brought suit to determine title and rights in certain land located within the limits of a public road which ran to and beyond a public lake. The dispute concerned a strip of beach between the traveled way and the water's edge. Being a public lake, any member of the public could exercise a common law right to boat, bathe, fish, skate, and cut ice in and on its waters. The court found that the road had not been abandoned nor its use discontinued; therefore, any member of the public could use the road to reach the waters. The court held, however, that the public did not have the right to use privately owned shore front property. (Plaintiffs owned the shore front property up to the high water mark of the pond). Further, the public could not park on the public road for the purpose of recreational use of the pond, since such parking would not be incident to a viatic use of the right-of-way and would therefore not be within the original purpose of the easement granted for the road. (Scott-Fla)
W69-02739

GRATTO V PALANGI (USE OF GREAT PONDS).

147 A 2d 455-460 (Me Sup Jud Ct 1958).

Descriptors: *Maine, Judicial decisions, Water law, *Great ponds, Lakes, Swimming, Boating, Beaches, *Recreational facilities, Safety.

Plaintiff, a child, brought a companion action for injuries sustained by her when she was struck by a motorboat while bathing at defendant's public bathing beach on a great pond. Under the great pond rule, the defendant had no possession or control of the swimming area because the waters are public waters. The beach proprietor could not prevent boats from entering the swimming area. Swimming and boating are obvious uses of great ponds, and a swimmer must share the use of them with boats. The defendant was found not negligent. (Childs-Fla)
W69-02740

COCANIG V CITY OF CHICAGO (WATER SUPPLY).
21 111 2d 464, 173 NE 2d 482-485 (1961).

Descriptors: *Public utilities, *Water supply, Land governments, *Legislation, Remedies, Legal aspects, Judicial decisions, Cities, *Domestic water, Illinois.

The plaintiff homeowners brought action to enjoin the City of Chicago from shutting off their water supply. The controversy arose over a water bill that was not paid by a former owner. The court held that the landowners were not liable for the bill and that the city could not turn off the water supply. The city could have followed procedures set forth in a city ordinance for collection of the bill, but it did not. Cutting off water to the present owners is a remedy unavailable to the city. (Horner-Fla)
W69-02742

STATE V CITY OF AKRON (WATERCRAFT LICENSING).
168 NE 2d 500-504 (Ohio C P 1960).

Descriptors: *Judicial decisions, *Ohio, Reservoirs, Cities, Beds, Legislation, *Permits, *Boating regulations, Boats, Ownership of beds, Local governments.

Ohio brought suit against the city of Akron to permanently enjoin it from requiring licenses to be purchased by boatowners using the city waterworks reservoirs. The state relied upon a statute requiring state licensing of watercraft and precluding any political subdivision of the state from charging any fee for such. The city answered by saying that the statute as it applied was unconstitutional as a taking of private property without compensation and due process and as a restriction on the constitutional right of a municipal corporation to own and operate a public utility. The court held for the city and declared the Watercraft Act unconstitutional and void as applied in this situation. Property which a municipality operates in a proprietary capacity is to be treated as private property. The city owned the bottoms of the reservoirs, and since they were impounded from non-navigable streams, it had exclusive control of the waters. Thus, the statutory restriction was a taking of an incident of ownership or property right. The court also agreed that the statute was in conflict with a municipality's constitutional right to operate a public utility. (Williams-Fla)
W69-02743

JACKSON V CITY OF MADISON (LAKE BEDS).
12 Wis 2d 359, 107 NW 2d 164-169 (1961).

Descriptors: Permits, *Legislation, State governments, Local governments, *Wisconsin, *Ownership of beds, Submerged beds, Legal aspects, City planning, Lakes, *Lake beds, Recreation facilities, Land reclamation, Boundaries (Property), Water law, Judicial decisions, Cities, Navigable waters.
Identifiers: *Lake Monoma.

This is a taxpayer's action for a declaratory judgment on issues involving an auditorium and parking ramp which the city proposes to build on filled in land in Lake Monoma. The issues before the court were: (1) whether it would be a gross abuse of discretion by the Madison City Council to spend $5,500,000 to build the auditorium and parking ramp on the bed of Lake Monoma, which was owned by the state and for the use of which the state had granted to the city only a revocable permit, and (2) whether existing statutes prohibited such construction. The court held that the Madison City Council had the state's permission to construct the facilities and that it was not an abuse of discretion simply because the state could divert the site to another public purpose sometime in the future. With respect to the second issue, the court held that the access provided by the proposed project was consistent with the legislative intent of the relevant statuatory provisions. (Smith-Fla)
W69-02744

SZESTOWICKI V WATER RESOURCES COMM'N (REQUEST FOR PERMIT TO EXTEND PIER).

156 A 2d 197-200 (Conn 1959).

Descriptors: *Water Resources Commission, *Piers, Navigable water, *Docks, *Piles, Dredging, Harbor improvements, Administrative proceedings, Permit, Navigation, Shoreline, Shores, Connecticut.

The owner of upland, which fronted on a small semicircular cove on a river, sought permits for the construction and extension of two lines of piers, piles, and accessory floats, for a distance of 400 feet from the shoreline and for certain dredging in the river in connection therewith. The Water Resources Commission found that the proposed construction would reach into navigable water and would interfere with navigation and access to neighboring piers. The court found on review that the commission's findings were neither arbitrary nor unreasonable, and therefore affirmed the denial of the permits. (Rief-Fla)
W69-02745

6F. Nonstructural Alternatives

WISCONSIN'S SHORELAND AND FLOOD PLAIN PROTECTION PROGRAM,
Wisconsin Bureau of State Planning, Madison.
Donald F. Wood.
Water Resources Research, Vol 4, No 6, pp 1375-1379, December 1968. 5 p, 4 ref.

Descriptors: Wisconsin, *Flood protection, *Shore protection, Water management, Zoning, Building codes, Benefits, Costs, Water pollution, Administration.
Identifiers: Regional planning agencies, Sanitary codes, Water resource problem, Shoreland protection, Flood plain protection.

The State of Wisconsin has undertaken a bold program of regulating shoreland and flood plain uses in an attempt to overcome certain water resources problems. The program is too new to have its effectiveness evaluated. Nonetheless, in future years the program's success and shortcomings deserve considerable attention by all persons concerned with water resource management. (Seneca-Rutgers)
W69-02550

PERCEPTION OF FLOOD HAZARD IN A SMALL NEW JERSEY TOWN,
Rutgers-The State Univ., New Brunswick, N. J.
Jacquelyn Beyer.
Proceedings of the Third Annual American Water Resources Conference, 1967, pp 415-435. 21 p, 10 tab, 4 fig, 25 ref.

Descriptors: *Flood damage, Flood plains, Flood, Flood control, Flood protection, New Jersey, Flood plain insurance, Decision making.
Identifiers: *Flood hazard perception, *Blairstown, Soil Conservation Service, Certainty-uncertainty continuum, Information dissemination.

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Flood damages affect a broad range of occupiers of flood hazard areas. Planners need to know as much as possible about how decisions concerning the flood hazard are made. This study considers the individual's decision making process in one community on a small tributary stream. A major recommendation for change in current management policy is for improved flood hazard information, including information about the range of possible adjustments. It would be useful to be able to measure the potential effectiveness of such information in given areas. One such measure has previously been suggested in the form of a certainty-uncertainty scale. Blairstown can be ranked on the scale as high in uncertainty. This indicates a high degree of difficulty in disseminating more complex and/or more complete information. There are, however, opportunities for exploiting latent interest in floodproofing and in clarifying misconceptions about the role of insurance. More emphasis on regulation might also be useful. Timing of information becomes critical where the restraints of experience are so intense. (Seneca-Rutgers)
W69-02554

WATER MANAGEMENT IN CENTRAL AND SOUTHERN FLORIDA,
Central and Southern Florida Flood Control District.
G. D. Dail, Jr.
Florida Planning and Development, Vol 19, No 6, June 1968, p 1, 8-11.

Descriptors: *Water resource management, *Flood control, Recreation, Administrative decisions, Adoption of practices, River basin planning, Wildlife conservation, Preservation, Public benefits, *Administrative agencies, Recreation demand, Water districts, State governments, Project planning.
Identifiers: Kissimmee River Basin, Upper St. Johns River Area, The Everglades, Central and Southern Florida Flood Control Project, Florida.

In the initial settlement many water management problems confronted the settlers in central and southern Florida. Floods threatened the continued habitation of certain areas, but all efforts by state and private enterprise during the late 19th and early 20th centuries to drain flood waters from the interior proved inadequate. Following a gigantic flood which inundated more than five million acres, the State of Florida finally began flood control. In 1948 the Central and Southern Florida Control Project was initially authorized by Congress. The Flood Control District, comprising these areas, was created in 1949 by the Florida legislature and given the responsibility of cooperating with the Federal government in building the system. Today the Federal Control District is operating and maintaining a system that includes about 1,500 miles of canal and levees, pumping stations, and more than 75 large spillways and dams. The system is unique in providing flood control by conservation, the Kissimmee Basin, Upper St. Johns River area, and Everglades are major areas in the Flood Control District water management projects. A byproduct of this has been the creation of vast areas which are available to the public for recreational purposes and wildlife conservation. (Gargola-Chicago)
W69-02800

07. RESOURCES DATA

7A. Network Design

DIGITAL TRANSMISSION OF COLLECTED WATER QUALITY DATA,
Arkansas Univ., Little Rock. Dept. of Electronics and Instrumentation.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-02406

WATER LEVEL FLUCTUATION IN EVAPOTRANSPIROMETERS,
Geological Survey, Phoenix, Ariz.
For primary bibliographic entry see Field 02D.
For abstract, see .
W69-02569

7B. Data Acquisition

ELECTROCHEMICAL TRANSDUCERS FOR WATER QUALITY,
Arkansas Univ., Little Rock. Dept. of Electronics and Instrumentation.
For primary bibliographic entry see Field 05A.
For abstract, see .
W69-02407

CIRCULATION AND MIXING PROCESSES IN LAKES,
Wisconsin Univ., Madison. Water Research Center.
For primary bibliographic entry see Field 02H.
For abstract, see .
W69-02489

CALIBRATION AND EVALUATION OF A WIDE-RANGE GRAVIMETRIC METHOD FOR MEASURING MOISTURE STRESS,
Geological Survey, Denver, Colo.
Irel S. McQueen, and Reuben F. Miller.
Soil Sci, Vol 106, No 3, pp 225-231, 1968. 7 p, 1 fig, 2 tab, 14 ref.

Descriptors: *Soil moisture, *Soil moisture meters, *Moisture tension, *Instrumentation, Calibrations, Soil water, Wettability, Hydrologic properties, Methodology.
Identifiers: *Stress sensor, Filter paper, Filters.

A method of determining the soil moisture stress of field samples by sealing pieces of filter paper into the sample container but not in contact with the sample is described. The samples and paper discs are allowed equilibrate at 20 deg C for at least a week. Samples must be handled with care; grain rearrangement changes moisture stress without change in water content. After equilibration the paper is accurately and rapidly weighed. Moisture stress may be computed from the moisture content of the filter paper or it may be obtained from a calibration plot. The method is effective over a stress range of 0.001 to 1,500 bars. The accuracy is as good as or better than that of other commonly used methods. (Knapp-USGS)
W69-02509

POLLUTION SURVEILLANCE BY NONCONTACT INFRARED TECHNIQUES,
Texas Instruments, Inc., Dallas.
J. R. Van Lopik, G. S. Rambie, and A. E. Pressman.

J Water Pollut Contr Federation, Vol 40, No 3, Part 1, pp 425-438, Mar 1968. 14 p, 14 fig, 10 ref.

Descriptors: *Remote sensing, *Path of pollutants, *Water pollution, *Monitoring, Surveys, Pollutant identification, Assessments, Instrumentation, Methodology, Texas.
Identifiers: *Infrared techniques, Galveston Bay.

Airborne infrared mapping techniques and their application to identification and monitoring of pollutants in streams and other bodies of water are described and illustrated. Thermal, organic and inorganic pollution can be determined and monitored, thus providing for rapid means to make on-the-ground measurements and, with aerial surveys, synoptic assessments of pollution parameters. Infrared mapping methods show the differences in infrared radiation flux over the area mapped. Sensing of temperature by this means can be used to map isotherms in water bodies and to trace thermal pollution, such as has been done in Galveston Bay. Proper selection of wavelengths allows identification of contaminants by their spectral emissivity characteristics. (Lang-USGS)
W69-02516

ULTRAVIOLET ABSORBANCE AS AN INDEX OF THE POLLUTION OF SEAWATER,
Tokyo Metropolitan Univ. (Japan).
Norio Ogura, and Takahisa Hanya.
J Water Pollut Cont Federation, Vol 40, No 3, Part 1, pp 464-467, Mar 1968. 4 p, 5 fig, 1 tab, 7 ref.

Descriptors: *Indicators, *Water pollution, *Seawater, *Ultraviolet radiation, Spectometer, Chemical oxygen demand, Turbidity.
Identifiers: *Spectometry, Ultraviolet adsorption, Tokyo Bay.

A study of several bays in Japan shows that ultraviolet absorption can be used effectively as an indicator of organic pollution in coastal waters. Coastal seawater is subject to pollution by drainage from the land and by wastes from ships. Transparency and chemical oxygen demand often are used as criteria to determine pollution. Absorbance of seawater is due mainly to organic matter and bromides, and absorbance of coastal water is higher than that of the open sea. Drainage from the land lowers the bromide absorbance but raises the absorbance attributable to organic matter. An increase in chemical oxygen demand and a decrease in transparency accompany increases in non-bromide absorbance. (Lang-USGS)
W69-02517

A COMPOSITE-GRAB OF WATER POLLUTION CONTROL SAMPLING,
Iowa State Water and Pollution Control, Ames.
Robert F. Roskopf.
J Water Pollut Cont Federation, Vol 40, No 3, Part 1, pp 492-498, Mar 1968. 7 p, 9 ref.

Descriptors: *Sampling, Water pollution control, Sewage treatment, Water treatment, Monitoring, Instrumentation, Statistical methods, Industrial wastes.
Identifiers: *Sampling types, Basic data.

Sampling, an often misunderstood but very important part of water pollution control activities, is discussed. Factors that complicate the obtaining of representative samples include place of sampling, timing of sampling, flow metering, and sample preservation. Sampling is necessary in the control of industrial wastes, wastewater treatment plant design, plant operation, and control of stream pollution. An effective sampling program will have well-defined objectives and scope, be worth the money invested in it, and be designed with due regard for laboratory and other personnel, suitable equipment, and safety. Statistics should be used for designing the program and interpreting its results. Adequate but concise records are important. (Knapp-USGS)
W69-02519

LASER INSTRUMENTS FOR MEASUREMENTS,
General Precision Systems, Inc., Pleasantville, N Y.
R. A. Flower.
Mech Eng, Vol 90, No 10, pp 27-31, Oct 1968. 5 p, 2 fig, 19 ref.

Descriptors: *Measurement, *Measuring instruments, *Laser, Alinements, Cargon dioxide, Bibliographies, Rotation, Interferometers, Spectroscopy, Velocity meters, Optical instruments, Surveying, Surveying instruments, Water measurement, Plasma physics, Direction finding, Chemical analysis, Altimeters.
Identifiers: Gyroscopes, *Optical measurements, Doppler effect.

The laser has greatly improved optical measurement techniques for distance, velocity, departure from reference axis, angular rotation, and other uses in alinement and linear measuring. Laser echo ranging systems are comparable to microwave radar ranging systems in maximum range and accuracy, and have advantages in situations requiring extremely narrow transmitting beam widths. Laser

interferometers have a theoretical capability to operate with path length differences of hundreds of miles as compared to path lengths of several feet for conventional optical interferometry. Alinement measurements are possible over long distances, even in direct sunlight, due to the intensity and narrowness of the laser beam. Velocity measurements may be made by Doppler shifts or by detecting the motion of the random diffraction pattern produced by laser scattering from a moving target surface. Some potential future laser applications include a rotation sensor or laser gyroscope, absorption spectroscopy for identifying chemical elements, determining carbon dioxide content in a gaseous mixture by an optical resonance method, and measuring electron density of a plasma by determining the dielectric constant of a region from the medium's optical wave length via the laser interferometer technique. (USBR)
W69-02577

SEMI-QUANTITATIVE DETERMINATION OF GROUNDWATER QUALITY FROM SURFACE ELECTRICAL MEASUREMENTS,
Huntec Ltd., Toronto (Ontario).
Tsvi Meidav.
Soc Explor Geophys 35th Annu Meet, Dallas, Tex, Nov 1965. 18 p, 4 fig, 6 ref.

Descriptors: *Groundwater, *Water quality, *Salinity, Measurement, *Electrical resistivity, Arid land, Aquifers, Porosity, Rocks, Wells, Permeability, Hydrology, Geology, Evapotranspiration, Alluvial deposits, Water table, Phreatic line, Alluvial streams, Nomographs, Conductivity, Foreign research.
Identifiers: Iran, Geoelectricity, Groundwater hydrology, *Groundwater quality.

Determining the ground-water quality of alluvial beds from surface geoelectrical measurements is complicated by the fact that measured resistivity is a function of many factors, such as the ratio of clay to combined sand and gravel, porosity, percent saturation, and water salinity. Relationships among total sample resistivity, saturating liquid resistivity, and texture of the soil and rock are discussed; empirical equations are given. The study, made in arid regions of Iran, indicates that an inverse relationship exists between ground-water salinity and apparent resistivity measured on the ground surface. The linear factor, determined by correlation with known conditions, was successfully employed to predict the presence of a confined sweetwater aquifer underlying a highly saline phreatic aquifer. A nomogram is presented for determining formation factors and converting surface resistivity to sodium chloride equivalents for a given formation factor. Accuracy for determining ground-water conductivity depends upon the constancy of the formation factor through the investigated region. (USBR)
W69-02594

REFLECTION SEISMICS IN ENGINEERING GEOPHYSICS,
Huntec Ltd., Toronto (Ontario).
Tsvi Meidav.
Soc Mining Eng AIME, Minneapolis, Minn, Sept 1968. 35 p, 18 fig, 7 ref.

Descriptors: *Geophysics, *Seismic investigations, Seismic waves, Wave velocity, *Seismographs, Explorations, Engineering geology, Wave length, Subsurface investigations, Geologic investigations, Instrumentation, Reflection, Longitudinal waves, Transverse waves, Geophones.
Identifiers: Foreign products, Canada, *Seismic reflection.

The seismic reflection method has many advantages over the seismic refraction method, but has not been exploited in engineering geophysics. The advantages are based on richness of subsurface detail, absence of restrictions from blind zones or hidden layers, and no encumbrances as the refraction method's requirements for a receiver spread to be many times longer than the deepest refractor. The main problem in exploiting the reflection method in engineering geophysics is separation of the superimposed waves at short record times. Velocity filtering removes undesirable waves, leaving a substantial usable reflection even at short record times. Special circuitry has been developed to sense the time lag of positive zero crossings of the signal at 2 separate geophones, and to record only arrivals having a phase shift smaller than an arbitrarily set amount. Fundamentals of analysis for an expanding reflection spread are reviewed. Field examples demonstrate the abilities and limitations of the present technique. (USBR)
W69-02595

AIRPHOTO INTERPRETATION AS AN AID IN FLOOD SUSCEPTIBILITY DETERMINATION,
Department of Energy, Mines and Resources, (Canada).
Lawrence C. N. Burgess.
Int Conf Water Peace, Washington, D C, May 1967. 16 p, 1 tab, 12 ref.

Descriptors: *Aerial photography, Photography, Photographs, Erosion, *Flood plains, Flood damage, Vegetation, Sedimentation, Geomorphology, Land management, Water utilization, Water resources, Meteorological data, Watersheds (Basins), Topography, *Flood plain zoning, Floodwater, *Flood forecasting.
Identifiers: Flood estimate, *Photointerpretation.

Airphoto interpretation is an effective method of obtaining unique flood susceptibility information. Through perceptive interpretation of available aerial photographs, the extent, nature, and relative frequency of floods can be determined. Special photography during flooding or subsequent to a major flood is not required to obtain these results. While effects of major floods are obvious, occurrence of consecutive minor floods leaves distinct indicators on the flood plain. Cumulative effects of all overbank flow may be detected directly from observable natural and cultural features, and indirectly by inferences drawn from adjustment of man and vegetation to flood plain conditions. Clues that indicate flood susceptibility may be used either singly or grouped to determine the potential of an area for erosion, sedimentation, extremes in flood velocities, and duration and extent of inundation. Areas subject to destructive water-current velocities (heavy sedimentation and slack-water inundation) can be delineated to plan for the most efficient flood plain land use. Resolving resource-use conflicts, such as between flood control measures and recreation values, or between irrigation and other water use, can be facilitated through airphotos to provide a broad perspective of watershed conditions. (USBR)
W69-02597

THE MEASUREMENT OF LOW FLUID VELOCITIES WITH THE AID OF A TETHERED SPHERE,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
Heinz Stefan, and Frank R. Schiebe.
Water Resources Res, Vol 4, No 6, pp 1351-1357, December 1968. 7 p, 6 fig, 1 tab, 1 ref.

Descriptors: *Instrumentation, *Current meters, *Hydraulic models, Laminar flow, Turbulent flow, Open channel flow, Model studies, Laboratory tests.
Identifiers: Low velocity fluid flow, Tethered sphere current meter.

Two- or three-dimensional velocity fields in hydraulic models can be measured with the aid of a tethered sphere if the absolute velocity values are very small. The apparatus is relatively simple and quite sensitive. Experimental data can be handled numerically, taking into account all effects, and printout is readily available in useful tabular or graphical form. The greatest disadvantage at present seems to be that the position of the tethered sphere is not stable, and it is difficult to define when turbulence is present in the flow. The average position of the sphere will most probably not correspond to the velocity average in this case. This disadvantage is, however, shared by most velocity measuring devices with low frequency response. The second inaccuracy is that the program presently available is based on the assumption that the velocity is uniform over the height of the probe. The development of a new program taking into account continuously varying velocity and temperature profiles is in progress. It is of particular importance for small spheres on long support lines. The instrument may also be inverted by using a sphere slightly heavier than water. Such an instrument would be suitable for velocity measurements near the bottom of a channel.
W69-02668

DENSITY AND MOISTURE CONTENT MEASUREMENTS BY NUCLEAR METHODS,
Research Triangle Inst., Durham, N. C.
R. P. Gardner, and K. F. Roberts.
Nat Coop Highway Res Program Rep 43, 38 p, 1967. 14 fig, 23 tab, 3 append, 9 ref, and list of 42 pub rep on highway res.

Descriptors: *Soil moisture meters, *Soil density probes, *Nuclear moisture meters, *Calibrations, On-site tests, Methodology, Instrumentation.
Identifiers: *In situ calibration, Air-gap calibration, Dual-gage calibration, Nuclear soil moisture meters, Calibration handbooks.

A method is presented for calibration of nuclear soil-moisture gauges to make consistent, reproducible, accurate field soil moisture and soil density measurements. Nuclear moisture meters are sensitive to soil composition, poor calibration techniques, and soil density. Calibration models were developed and curves drawn to enable stable homogeneous non-soil calibration standards to be used. Standards and models for each available type of gauge were found and tested. A dual-gauge compensation for soil composition variation was developed. The model developed explains and optimizes the air-gap method of using this principle. It is concluded that this calibration method should be used with the air-gap method for field use with commercially available nuclear density meters. The calibration method for each available meter is explained in a handbook included in 2 appendices. (Knapp-USGS)
W69-02676

RADIOACTIVE TRACING OF STORM RUNOFF ON A SMALL CATCHMENT I EXPERIMENTAL TECHNIQUE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02769

RADIOACTIVE TRACING OF STORM RUNOFF ON A SMALL CATCHMENT II DISCUSSION OF RESULTS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 02E.
For abstract, see .
W69-02770

TRITIUM MEASUREMENTS IN NATURAL HAWAIIAN WATERS: INSTRUMENTATION,
Hawaii Univ., Honolulu. Water Resources Research Center.
L Stephen Lau, and Tsegaye Hailu.
Water Resources Research Center, Tech Rpt No 22, Nov 1968. 36 p, 13 fig, 2 tab, 40 ref. OWRR Project A-016-Hi.

Descriptors: *Tritium, Hawaii, Liquid scintillation, Electrolysis, Rainwater, Surface water, Ground water, Ocean water.
Identifiers: *Instrumentation, Water.

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All known tritium measurements made of Hawaii rainwater, ocean water, surface water, and ground water are summarized. Ocean water yielded 10 to 20 T.U. in 1963-65. Tritium in rainwater rose from a low 6 T.U. in 1961 to a 1963 summer peak of 373 T.U., exhibited strong seasonal fluctuations, and declined to 43 T.U. in mid-1965. Ground water samples collected in late 1966 on Oahu ranged between 24 to 0.5 T.U. Ground-water samples with high tritium count were taken from high-level water; those with considerably less tritium were basal water and the one with the least tritium was basal water farthest down gradient and below a 1100-foot caprock in Ewa Beach, Oahu. The facilities of the Tritium Laboratory at the University of Hawaii are described. The present basic unit for tritium analysis utilizes liquid scintillation with electrolysis for enrichment of low-level samples.
W69-02781

AN OPTIMIZATION SCHEME FOR GAGING,
Harvard Univ., Cambridge, Mass.
Myron B, Fiering.
Water Resources Res, Vol 1, No 4, pp 463-470, 4th Quart 1965. 8 p, 8 tab, 8 ref.

Descriptors: Correlation analysis, Data collections, Digital computers, Distribution patterns, Discharge measurement, *Gaging stations, Hydrologic data, Least squares method, Mathematical models, *Optimization, Regression analysis, River flow, *Sampling, *Statistical methods, *Stream gages.
Identifiers: Nonlinear integer programming.

The conjunctive use of nonlinear integer programming and principal component analysis was suggested for specification of a constrained optimal gaging program whose objective was to define efficient estimates of the several annual means. The assumptions in the analysis were that data from all the study sites were available for a certain number of years, and a certain number of years of additional gaging was contemplated. The observations were presumed to derive from a multivariate normal population with no serial correlation. The method specified which sites from among the original observation sites should be continued, and which should be estimated by linear regression. It was concluded that for systems where the number of sites exceeded 5, a digital computer would be required to identify the constrained optimums. Although the discussion was directed toward hydrologic applications, it was stated that the technique is generally applicable to sampling surveys. (Gysi-Cornell)
W69-02791

7C. Evaluation, Processing AND Publication

ESTABLISHMENT OF WATER QUALITY LABORATORY AND SYSTEM FOR STORAGE AND RETRIEVAL OF INFORMATION,
South Dakota State Univ., Brookings.
John L. Wiersma.
Technical Completion Report to Office of Water Resources Research, Department of the Interior, November 1968, Washington, D. C., 16 p. OWRR Project A-009-SDak.

Descriptors: Laboratories, *Research facilities, Data collections, *Data storage and retrieval, *Information retrieval, Computer program, Water analysis, Laboratory tests.

A laboratory facility which would provide an adequate centralized unit for research and training in the area of water quality has been established in cooperation with other units of the South Dakota State University. The laboratory is now equipped with modern facilities with capability of making nearly all chemical and biological analyses needed in water research. The water quality data collected from this laboratory and laboratories within the State has encouraged the establishment of a storage and retrieval system of water quality data. The system is known as the 'SODAK' System, which accepts data in raw form without dictating the form of laboratory analysis sheets and converts the data to a uniform format. The system has three programs: (1) The translator program, (2) the sorter program, and (3) the logic selective search program. The translator program supplies proper coding of supplied data. The sorter program processes the translated stored data as required by the selective search program. The selective search program is supplied by the potential user and is built around the logic statements 'IF', 'AND IF', 'OR IF', and 'SAVE', thus allowing the user to construct a search routing that satisfies his needs by selection or rejection of any stored data.
W69-02468

WATER-LEVEL TRENDS IN SOUTHEASTERN LOUISIANA,
Geological Survey, Baton Rouge, La. Water Resources Div.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-02513

SURVEY OF PROGRAMS FOR WATER-SURFACE PROFILES,
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 08B.
For abstract, see .
W69-02556

LABORATORY EVALUATION OF SELECTED RADIOISOTOPES AS GROUND WATER TRACERS,
Texas A and M Univ., College Station.
A. Ray, Jennings, and Melvin C. Schroeder.
Water Resour Res, Vol 4, No 4, pp 829-838, Aug 1968. 10 p, 2 fig, 3 tab, 16 ref.

Descriptors: *Tracers, *Radioactive isotopes, Groundwater, Half life, *Groundwater flow, Aquifers, Velocity, Laboratory tests, Bibliographies, *Groundwater movement, Water measurement, Shales, Limestones, Strontium radioisotopes, Ion exchanges.
Identifiers: Chromium radioisotopes, Ruthenium radioisotopes, Cerium radioisotopes, Chelating agents.

An ideal ground-water tracer, moving at the same rate as the water, does not exist for use in all types of aquifers. Laboratory tests can give some indication of the suitability of a tracer under particular conditions before field tests. Antimony 121, cerium 141, chromium 51, indium 114, ruthenium 103, and strontium 85 were tested in chelate form. Ion exchange measurements were made under static conditions for crushed illitic shale and limestone, and used to predict the elution history of a tracer from an exchange column. Comparing predictions, tracer elution histories, and elution histories for chloride pulses indicates that chelated chromium 51 is an adequate ground-water tracer. Average ground-water velocity is equal to the sum of tracer velocity plus the product of tracer velocity, distribution coefficient, and bulk density of the aquifer divided by effective porosity. An ideal tracer has a zero coefficient of distribution and an average velocity equal to the average ground-water velocity. The best index for determining average water velocity is the arrival of the maxium tracer concentration, resulting from movement along the most direct flow path. (USBR)
W69-02571

A LAG-DEVIATION METHOD FOR ANALYZING CHANNEL BED FORMS,
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.
For primary bibliographic entry see Field 02J.
For abstract, see .
W69-02670

ELECTRICAL-ANALOG ANALYSIS OF HYDROLOGIC DATA FOR SAN SIMON BASIN COCHISE AND GRAHAM COUNTIES, ARIZONA,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02F.
For abstract, see .
W69-02678

SYNTHESIZING DAILY DISCHARGE FROM RAINFALL RECORDS,
Geological Survey, Carson City, Nev.
Donald O. Moore.
ASCE Proc, J of Hydraul Div, Vol 94, No Hy5, Pap 6119, pp 1283-1298, Sept 1968. 16 p, 11 fig, 5 tab, 5 ref.

Descriptors: *Hydrographs, *Synthetic hydrology, *Streamflow forecasting, Unit hydrographs, Base flow, Precipitation (Atmospheric), Runoff, Hydrograph analysis, Recession curves, Methodology.
Identifiers: Hydrograph synthesis, Daily discharge synthesizing.

A graphical method of synthesizing hydrographs of daily mean streamflow from precipitation records is described. The method described requires four distinct operations: (1) Determination of the mean depth of daily precipitation over the drainage basin, (2) determination of the precipitation excess, (3) determination of the time distribution of each increment of storm runoff, and (4) determination of the amount of base flow that should be added to the direct runoff to give to total flow. The method has produced good results, where it has been tested, in forecasting flood hydrographs from precipitation.
W69-02694

08. ENGINEERING WORKS

8A. Structures

SOUTH RIVER TIDAL DAM PROJECT, SPECIAL REPORT 21.
New Jersey State Dept. of Conservation and Economic Development.
For primary bibliographic entry see Field 04B.
For abstract, see .
W69-02506

ADVANCED PIPELINE TECHNOLOGY FOR IRRIGATION PROJECTS,
United Technology Center, Sunnyvale, Calif.
Allen Porter.
Space Age Irrig Symp, Huron, S Dak, June 1968. 31 p, 6 fig, 4 tab, 2 append.

Descriptors: Pipelines, *Pipes, *Water pipes, Reinforcing, Composite materials, *Mortars, Glass fibers, Plastics, Costs, Chemical properties, *Closed conduits, Mechanical properties, Hydraulics, Irrigation systems, Plastic pipes, Materials.
Identifiers: Polyesters, Thermosetting plastics, *Fiberglass plastic pipes, Glass reinforced plastics, *Reinforced plastic mortar pipe.

Reinforced plastic mortar (RPM) pipe, a composite material made of a synthetic resin-sand mortar with fiberglass reinforcement, is designed specifically for water and waste conveyance systems for agricultural and domestic use. The manufacturing process is discussed and pipe configurations are given. Mechanical properties, hydraulic characteristics, chemical inertness, and design considerations are covered. In addition to testing programs sponsored by the developer of the pipe, independent tests are being conducted by the National Sanitation Foundation for toxicology, and the Bureau of Reclamation for hydraulics, structural strength, and durability. Draft specifications have been prepared by ASTM, and testing by Underwriters Laboratories will begin soon. Applications have included installing thin-wall RPM pipe inside an existing failed concrete irrigation main,

and converting an open canal to a closed conduit system. Initial costs appear economically attractive as size and working pressure increase, particularly in sizes above 15-in. dia. Cost savings are possible in installing RPM pipe because of its lightweight and superior handling characteristics, and because favorable hydraulic characteristics may allow using smaller-diameter pipe. (USBR)
W69-02559

ARROW,
CBA Engineering Ltd., Vancouver (British Columbia); and Cementation Co. Ltd., Rickmansworth (England).
J. W. Gadsby, and F. A. Bares.
Can Geotech J, Vol 5, No 3, pp 127-141, Aug 1968. 15 p, 10 fig, 3 tab, 10 ref.

Descriptors: *Cofferdams, *Cutoff walls, Cutoffs, *Granular materials, Cutoff trenches, Slurries, Bentonites, Foreign construction, Impervious materials, Hydraulic structures, Construction, Grouting, Cores, Geology, Costs, Seepage.
Identifiers: Blasting, *Arrow Dam (Canada), Canada.

Arrow Dam stores Columbia River water in southeast British Columbia. A sand and gravel cofferdam protected the concrete control structures during construction. The central impervious membrane of the cofferdam was a concrete cutoff wall keyed into bedrock and formed by the slurry trench process. The upper core was built of compacted impervious till. The cofferdam withstood a maximum hydraulic head of 115 ft and remained in place for almost 2 yr. Maximum seepage was less than 600 (Imp) gal/ min. The cutoff wall cost about $21/sq ft and avoided the uncertainties associated with a pumping-type dewatering scheme. Weathered rock to 15 ft thick overlying bedrock was grouted through pipes installed in the cutoff wall. Blasting in holes on 3-ft centers removed the cutoff wall. The holes were charged with 16-in. cartridges, placed 4 feet apart, to provide a powder factor of 1.5 lb/cu yd of concrete. (USBR)
W69-02572

COMPARISON OF THE SOIL CORROSION RESISTANCE OF DUCTILE IRON PIPE AND GRAY CAST IRON PIPE,
American Cast Iron Pipe Co., Birmingham, Ala.
E. C. Sears.
Mater Prot, Vol 7, No 10, pp 33-36, Oct 1968. 4 p, 1 fig, 4 tab, 11 ref.

Descriptors: Experimental data, *Cast iron, *Pipes, Pipelines, Field tests, *Water pipes, Metallurgy, Iron, Thickness, Pitting, Soil surveys, *Corrosion, Corrosion control, Polyethylenes, Protective coatings, Durability, Specifications.
Identifiers: *Underground corrosion, Soil corrosiveness, *Gray cast iron, *Ductile cast iron, *Cast iron pipe, Corrosion resistance.

Soil corrosion resistance of ductile iron pipe is compared with gray cast iron pipe in a discussion of metallurgical characteristics, chemical composition, and soil corrosion field tests. The durability of cast iron, attributed to a graphitic layer formed during initial attack, is reviewed for better understanding of ductile pipe soil corrosion resistance. Soil corrosion tests conducted by the Cast Iron Research Ass, Stanton-Stavely Ltd of England, and National Bureau of Standards are discussed; analyses of National Bureau of Standards test results by several organizations are reviewed. Ductile iron and gray cast iron pipe are similar in several factors relating to comparative performance in pipeline service. The major difference is wall thickness; for comparable service conditions, ductile iron pipe generally can have less thickness because of its higher strength. With equal pitting, the thinner ductile iron pipe retains greater strength than gray iron pipe. Ductile iron pipe, with thickness specified in USA Standards, may be used in most soils with assurance of durability. In corrosive soils, polyethylene sleeving provides effective and economical protection. (USBR)
W69-02578

APPLICATION OF THE DYNAMIC THEORY OF SEISMIC STABILITY TO CALCULATION OF ARCH DAMS FOR LATERAL SEISMS,
An. A. Losaberidze.
Hydrotech Constr, No 7, pp 629-634, July 1967. 6 p, 10 fig, 5 ref.

Descriptors: *Arch dams, Dam design, Concrete dams, Horizontal loads, Dam foundations, *Seismic design, Seismic waves, Structural analysis, Earthquakes, *Lateral forces, Elastic deformation, Cantilevers, Seismic studies, Deflection, Deformation, Elasticity, Load distribution, Stress analysis, Model tests, Earthquake engineering, Foreign design practices.
Identifiers: Shakers, Seismic stability, USSR, Earthquake loads.

During an earthquake, horizontal waves in the earth's surface can approach a dam foundation from any direction relative to the longitudinal axis. Experimental studies of arch dam models showed that the most dangerous condition for stress in a dam arises from lateral seismic waves. Elastic vibratory motion of the body of a symmetrical arch dam in the vertical plane of symmetry, under the lateral action of seismic waves, can be approximated as 2 basic constituents: a skew-symmetrical bending oscillation as 2 half-waves, which satisfies the first skew-symmetrical form of the free-bending oscillation; and the skew-symmetrical oscillation of tension-compression for 2 zones, satisfying the first form of the free skew-symmetrical oscillation of tension-compression. To examine the first component of motion, the arch dam ideally is divided into a series of mutually acting horizontal arches and vertical cantilevers. The following assumptions are made regarding the second component of motion: basic components of movement are tangent to the axis of the arch; inertial forces will be developed in the base in a tangential direction, distributed as concentrated forces; the arches will undergo tension-compression deformation and the cantilevers, displacement-deformation. (USBR)
W69-02585

LARGE EARTHQUAKE FORCES ON GRAVITY DAM,
Imperial Coll. of Science and Technology, London (England).
N. N. Ambraseys, and S. K. Sarma.
Nature, Vol 219, No 5161, pp 1354-1356, Sept 1968. 3 p, 4 fig, 1 tab, 6 ref.

Descriptors: Concrete dams, *Gravity dams, *Earthquakes, Earthquake engineering, Hydraulic structures, Seismic design, *Accelerographs, Measuring instruments, Cracks, Motion, Recording systems, Seismic studies, Dams, Foreign research.
Identifiers: India, Koyna Dam (India), Seismic stability.

On December 10, 1967, an earthquake of magnitude 6.5 shook western India. Before the earthquake, a strong-motion accelerograph had been installed in a gallery in the body of Koyna Dam near the right abutment. At this point, the structure is 31 m high and the instrument was located about 12 m above foundation level. The instrument functioned properly during the earthquake, but a 3-component record produced was very faint and sometimes difficult to read. Interpretation of the recorded data is discussed. The transverse component showed a maximum acceleration of nearly 50% g; the average longitudinal acceleration exceeded 55% g. Records show that acceleration after 4 sec reached a peak value and returned to zero in about 50 msec. Thus, duration of these large inertia forces on the structure was very short, and damage to the dam was very slight. Recorded accelerations in the dam are assumed to be the same as ground accelerations because of the stiffness of the dam. The Koyna records show that severe loads (greater than 0.5 g) can occur on engineering structures because of earthquakes. The fact that the dam did not fail, although it was not designed to resist earthquakes, questions the validity of current seismic design methods. (USBR)
W69-02596

GOKCEKAYA ARCH DAM, COMPARISON OF THREE METHODS OF ANALYSIS,
N. P. Triano, and G. A. Kanakaris.
Amer Soc Civ Eng Conf, Pittsburgh, Pa, Aug 1968. 19 p, 5 fig, 6 ref.

Descriptors: *Arch dams, Concrete dams, Structural analysis, *Dam design, Dam foundations, Grout curtains, Foreign design practices, Model tests, Construction joints, Seismic design, Elasticity modulus, Geology, Thrust bearings, Monoliths, Design criteria, Cantilevers, Structural models, Safety, Trial-load method.
Identifiers: In situ tests, Allowable stress, Earthquake loads, Turkey, Gokcekaya Dam (Turkey).

Gokcekaya Dam is a 521-ft-high, thin, double-curvature arch dam located in Turkey. The dam axis spans 2 prominent projections along a gorge. Bedrock at the site is a hard, dark gray, massive, coarse-grained sericite-chlorite schist. In-place bearing tests determined the rock modulus of the foundation. A grout curtain varying from 30 m at the upstream face to 70 m at the downstream face was installed. Thrust blocks are provided at each abutment of the arch to distribute compression and shear forces imposed by arch loads. Allowable stresses for the concrete and foundations are 1000-psi compression and 150-psi tension for the normal reservoir level and dead load condition. These are increased 33-1/3% for temperature and earthquake loading conditions. Magnitude of the structure dictated that more than one method of investigation should be made for controlling the loading condition. Model tests and analytical methods (multiple cantilever) were used to analyze the design. Final design was verified by the trial-load method, based on radial, tangential, and twist adjustments. (USBR)
W69-02600

AN INTRODUCTION TO THE INSURANCE OF CONSTRUCTION PROJECTS,
Clarkson Arbon (Overseas) Ltd., London (England).
E. M. de Saventhem, and C. A. Muller.
London, Clarkson Arbon (Overseas) Ltd, Aug 1968. 19 p.

Descriptors: Construction, Economies, Contracting, Construction costs, *Insurance costs, Damages, Personnel, *Liabilities, *Claims, Accidents, Foreign countries, Benefits, Losses, *Contract administration, Risks, *Insurance, *Contracts.
Identifiers: Injuries, Great Britain.

Construction projects are becoming technically more ambitious and more costly. Owners must seek maximum protection against outside risks due to professional or financial inadequacy or failure of any firm selected to take part in completing the project, and to hazards potentially inherent in nature or location of the project, including accidental loss, damage, or injury. A fourfold system of safeguards devised by consulting engineers for the owner's protection includes: (1) bid and performance bonds, (2) retention monies, (3) Care of Works and Damage to Persons and Property clauses, and (4) Contractors' All Risks and Third Party Liability insurances. These safeguards and their practical applications mainly relating to performance bonds and insurance, are considered. Owners would derive considerable benefit from arranging (prior to issuance of invitations) an overall insurance to cover loss or damage to the works and property (their own or contractors') at the site, and liability for loss, damage, or injury to third parties (including property and personnel of owners or any contractor). (USBR)
W69-02603

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8B. Hydraulics

SURVEY OF PROGRAMS FOR WATER-SURFACE PROFILES,
Corps of Engineers, Sacramento, Calif.
Bill S. Eichert.
Amer Soc Civ Hydraul Div Conf, Massachusetts Inst Tech, Cambridge, Aug 1968. 33 p, 5 fig, 2 tab, 23 ref.

Descriptors: *Water-surface profiles, *Computer programming, Roughness coefficients, Hydraulics, Subcritical flow, Backwater, Bibliographies, Bridge piers, Supercritical flow, Cross sections, Technical societies, *Computer programs, Open channel flow.
Identifiers: FORTRAN.

Computer programs for determining water-surface profiles have been developed by Government agencies and private organizations. However, no single program has all of the desirable capabilities. Developing a satisfactory all-purpose computer program to meet the needs of many organizations will require much work. To accomplish this task and reduce duplication of effort, the writer suggests that ASCE or other professional organizations take the lead in organizing a committee to coordinate these efforts. This committee should collect, review, and report its findings on water-surface profile computer programs to the civil engineering profession through technical journals. Ultimately, the committee should direct or coordinate the development, testing, instruction, application, and documentation of such a computer program. The various parameters affecting the water-surface profile, to be incorporated in the different computer programs, are discussed. (USBR)
W69-02556

A CONTRIBUTION TO OPEN CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER,
Georgia Inst. of Tech., Atlanta; and Harza Engineering Co., Chicago, Ill.
C. S. Martin, and F. G. DeFazio.
Annu Conf Hydraul Div, Amer Soc Civ Eng, Massachusetts Inst Tech, Cambridge, Aug 1968. 49 p, 25 fig, 1 tab, 12 ref.

Descriptors: *Surges, Open channels, *Open channel flow, Computer programming, *Simulation, Waves (Water), Unsteady flow, *Bore (Wave), Finite differences, Flow, Hydraulics, Water surface profiles, Flood hydrographs, Hydrographs, Tailrace, Trapezoidal channels, Rectangular conduits, Junctions.
Identifiers: Bifurcations, Stoker method.

Equations of motion for unsteady, gradually-varied flow in open channels are expressed in a finite-difference form suitable for programming on a digital computer. The staggered-net scheme introduced by Stoker is expanded to apply to a system of N interconnected channels, with each of their ends subject to one of the following boundary conditions: discharge hydrograph, stage hydrograph, stage-discharge relationship, and dead end or junction of channels. The theory and computer program are tested and compared with existing experimental results corresponding to the following situations: (1) flood hydrograph in circular channel; (2) power-load rejection in headrace of trapezoidal canal; (3) power-load acceptance in tailrace of rectangular model channel; and (4) tidal (stage hydrograph) in rectangular model estuary. Because of good correlation between simulated and experimental results in all 4 instances, and the ease of coding various problems, the staggered-net scheme of Stoker is recommended. (USBR)
W69-02557

UNSTEADY FLOW SIMULATION IN RIVERS AND RESERVOIRS APPLICATIONS AND LIMITATIONS,
Tennessee Valley Authority, Norris.
Jack M. Garrison, Jean-Pierre Granju, and James T. Price.
Hydraul Div Spec Conf, Amer Soc Civ Eng, Massachusetts Inst Tech, Cambridge, Aug 1968. 75 p, 30 fig, 2 tab, 13 ref, 2 append.

Descriptors: *Unsteady flow, *Simulation, *Rivers, *Reservoirs, *Open channel flow, Transients, Computer programming, Waves (Water), Digital computers, Translatory waves, Discharges, Reservoir operation, Water surface profiles, Hydrographs, Hydraulics, Mathematical models, Waves, Flow, Flood hydrographs.
Identifiers: Stoker method.

A computer program for solving basic equations of unsteady flow in reservoirs and rivers is being used by TVA to solve various open-channel flow problems. The program has been used to: (1) investigate flow condition problems at the cooling water facilities of a nuclear powerplant, resulting from hydroplant operations at both ends of the reservoir, (2) determine velocity and stage variations in a narrow winding river below an existing hydroplant used for peaking operations, (3) determine timespace variations in discharge, velocity, and water surface elevation in a reservoir subjected to operations of a proposed pumped-storage plant, (4) determine unsteady flow conditions in a system of 2 large reservoirs connected by a 1.2-mi-long navigable canal, and (5) investigate reservoir acceleration effects on the passage of a flood wave through a proposed reservoir. Computer results and field measurements were in good agreement in the 3 cases where field data were taken, including reverse flows in 2 reservoirs and in the canal and locking operations in one of the river reaches. Results of these and a related transient study are described, explanations are given for several poorly understood phenomena occurring frequently in unsteady flows, and the mathematical model is described and evaluated. (USBR)
W69-02558

SEDIMENT DISTRIBUTION IN TURBULENT FLOW,
Universidad Central de Venezuela, Caracas.
For primary bibliographic entry see Field 02J.
For abstract, see .
W69-02564

ANALYSIS OF INTEGRATING-FLOAT FLOW MEASUREMENT,
Missouri Univ., Columbia; and Tennessee Valley Authority, Norris.
Henry Liu, and Larry D. Martin.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY5, pp 1245-1260, Sept 1968. 16 p, 4 fig, 2 tab, 26 ref, 3 append.

Descriptors: *Flow measurement, *Water measurement, Streamflow, Flow, *Discharge measurement, Flowmeters, Fluid flow, Turbulence, Hydraulics, Analysis, Accelerating, Spheres, Floats, Bibliographies.
Identifiers: *Integrating-float method.

The classical technique of streamflow measurement by the integrating-float method is reexamined. The effect of float acceleration on discharges measured by the technique is analyzed, using existing data for the acceleration of spheres in fluids in the gravitational field. Other sources of error, such as those due to nonuniformity of flow, turbulence, secondary currents, and fluid density stratification are described. After sufficient development, this technique may be particularly suitable for streamflow measurement at low velocities. Other potential advantages are indicated. (USBR)
W69-02583

CALCULATION OF STRESS VARIATION IN PRESSURE PENSTOCKS AT A HYDROELECTRIC STATION, UTILIZING AN EVTsM,
G. I. Nubel'man.
Hydrotech Constr, No 7, pp 635-640, July 1967. 6 p, 6 fig, 3 ref.

Descriptors: *Penstocks, *Stress, Transient stress, High pressures, Digital computers, Mathematical analysis, Water hammer, Discharges, Hydroelectric powerplants, *Optimum design, Mechanical engineering, Calculations, Safety, Speed regulators, Unsteady flow, Foreign research, Pressure vessels, *Stress analysis, Governors.
Identifiers: USSR, Accuracy, Bifurcations.

For the most economic installation at high-head hydroelectric powerplants, designers must precisely calculate stress variation in pressure penstocks resulting from regulation of units, unsteady flow, and from the turbines. Existing theoretical assumptions permit determination of these stress variations, although the process is time-consuming and inaccurate because of averaging methods used. The author proposes an electronic digital computer method of calculating stress variations in penstocks by creating mathematical models of the penstock and turbines. Various phases of the calculating procedure and results are presented. The author concludes that electronic digital computers may be used effectively for calculating pressure fluctuations in penstocks of hydroelectric powerplants or stable control systems, permitting automatic selection of optimal variants of powerplant equipment parameters. An electronic computer is needed to develop the information tables and monograms of water hammer in branched penstocks to be used in initial design stages. (USBR)
W69-02584

PLAN OF THE CHANNEL OF FREELY MEANDERING BENDS,
F. S. Tyrin.
Int Geol Rev, Vol 10, No 9, pp 1058-1062, Sept 1968. 5 p, 3 fig, 1 tab, 8 ref.

Descriptors: *Meanders, *Rivers, Channels, *Streams, Bends, Hydrology, Streambeds, Mathematical studies, River training, *Stream meandering, Foreign design practices.
Identifiers: Radius of curvature, USSR, *Curvature.

Reshaping the plan of a river channel is of great importance because of the ever-increasing construction of hydraulic and other engineering structures on the flood plains of rivers. The first problem is determining the curve of the plan of freely meandering bends, this being the most prevailing channel process in rivers of the plains. The radius of curvature of a streambed, at any given point, may be calculated from the median line of the streambed, obtained by the sequence of certain justifiable approximations, so that planar reconstitutions of freely meandering rivers may be ascertained without recourse to measurements on the ground. (USBR)
W69-02601

DESIGN OF OPTIMAL HYDRAULIC NETWORKS,
Boeing Co., Renton, Wash.
Shmuel L. S. Jacoby.
Amer Soc Civil Eng Proc, Vol 94, No HY3, pp 641-661, May 1968. 21 p, 4 fig, 3 tab, 8 ref, 2 append.

Descriptors: Digital computers, Discharge coefficients, *Economic efficiency, Efficiencies, Electric power costs, *Hydraulic design, Hydraulic properties, Hydraulic systems, *Mathematical models, *Network design, Networks, *Optimization, Pumps, Water distribution (Applied).
Identifiers: Boundary conditions, Hardy Cross procedure, Nonlinear programming.

The design of optimal hydraulic networks was formulated as a mathematical problem using the method of gradient-random-experience directions.

The network consisted of elements, nodes, and independent loops. Constrained by the continuity of flow at the nodes, the fluid properties, and friction loss relationships, cost functions were derived which depended on the pipe diameters and lengths, pump head, flow and efficiency, power cost, time period, and constants. The problem was formulated with boundary flow conditions (diameters and hydraulic-head as decision variables) or boundary head conditions (discharge and diameters as decision variables), based on the Hardy Cross procedure. It was treated as a continuous nonlinear optimization problem. The integer requirements of pipe and pump sized nearest the optimal solution were checked for feasibility. Numerical examples given seemed to terminate at various local minima, suggesting that precautionary starting procedures should be taken. Effects of changes in the network mode of operation or boundary conditions could be studied using the proposed formulation. (Gysi-Cornell)
W69-02621

MEASURING AND SAMPLING RUNOFF FROM FLAT LANDS,
Agricultural Research Service, Washington, D. C.; and Louisiana State Univ., Baton Rouge. Agricultural Experiment Station.
G. H. Willis, and J. M. Laflen.
Water Resources Res, Vol 4, No 6, pp 1347-1349, December 1968. 3 p, 1 fig.

Descriptors: *Instrumentation, *Runoff, *Overland flow, *Gaging stations, *Flumes, Sampling, Laboratory tests, On-site tests, Nitrates, Endrin, Silts, Clays.
Identifiers: Geib multislot divisor, Parshall flumes.

A system of measuring and sampling runoff was devised for use on nearly level lands by joining a Parshall flume and a Geib multislot divisor in series. The collected sample is pumped from a sump into above-ground storage tanks that have a capacity of 12 inches of runoff. The system remains functional even with drainage ditches at near capacity. Samples collected by the system were representative of the runoff water entering the system with regard to their silt and clay content and the concentration of added nitrate and endrin during the various flow rates and sediment concentrations tested.
W69-02682

8C. Hydraulic Machinery

FAULT SURGE VERSUS SWITCHING SURGE A STUDY OF TRANSIENT OVERVOLTAGES CAUSED BY LINE-TO-GROUND FAULTS,
Bonneville Power Administration, Portland, Oreg.
Edward W. Kimbark, and Alvin C. Legate.
Inst Elec Electron Eng Trans Power App Syst, Vol PAS-87, No 9, pp 1762-1769, Sept 1968. 8 p, 15 fig, 5 ref, append.

Descriptors: *Faults (Electrical), Circuit breakers, Transients, Extra high voltage, Transmission lines, Electrical impedance, *Surges, Energy, Economies, Investigations, Capacitors, Resistors, *Electric insulation, Oscillographs, Electric potential, Theory.
Identifiers: *Overvoltage, *Switching surges, *Switching, *Flashover, Shunt reactors, Network analysis.

Transient overvoltages caused by single line-to-ground short circuits on 3-phase transmission lines are studied. A method of decreasing such overvoltages is presented. Results are from tests made on the Bonneville Power Administration's transient network analyzer on a simulated 180-mi, 500-kv, 60-cycle, 3-phase unloaded line. When improvements in extra-high-voltage power circuit breakers now being studied are adopted, overvoltages caused by energization or reenergization of lines can be made so low that the limiting factor determining the amount the line insulation may be reduced might become the overvoltage produced by single line-to-ground faults. On lines insulated for levels below twice the normal line-to-ground crest voltage, such faults could develop into double line-to-ground faults, which would be particularly objectionable if single-pole switching were to be employed. (USBR)
W69-02561

EXPERIENCE IN OPERATION OF THE GOR'-KII HYDROELECTRIC STATION,
N. A. Alekseev.
Hydrotech Constr, No 9, pp 805-814, Sept 1967. 10 p, 7 fig, 8 tab, 2 ref.

Descriptors: *Hydroelectric powerplants, Earth dams, Spillways, Marl, Spillway gates, Foundations, Erosion, *Operations, Seepage, Navigation, Hydraulic turbines, Electric generators, Handling equipment, Settlement, Operation and maintenance, Foreign projects, Slope protection, Floods, Clays, Sands, Foreign construction, Hydraulic design.
Identifiers: USSR, *Gor'kii Powerplant (USSR), Power grids, Volga River (USSR).

The Gor'kii Hydroelectric complex, consisting of a 13,332-m-long earth dam, a spillway section, navigation structures, an 8-unit powerplant, and an outdoor switchyard, is the fourth in a chain of installations along the Volga. The complex is situated in an area underlain with sandy-clay deposits on top of a clayey-marl stratum. Seepage problems through the dam and powerplant are discussed; settlement of concrete structures has been recorded. Data are given on the powerplant structure, turbines, generators, handling equipment, and service facilities. The gravity-type spillway is 291 m long with 12 openings, 10 having 2-section gates and 2 having dual gates for wasting trash and floating debris. Operations are discussed, with particular emphasis on erosion in areas downstream of the powerplant and spillway. (USBR)
W69-02579

WHAT'S AHEAD FOR TUNNELING MACHINES,
Ingersoll-Rand Co., Princeton, N. J.
George Hill.
Proc Amer Soc Civ Eng, J Constr Div, Vol 94, No CO2, pp 211-231, Oct 1968. 21 p, 11 fig, 4 tab, 9 ref, 5 append.

Descriptors: *Tunneling, *Tunneling machines, Tunnels, Water tunnels (Conveyance), Evaluation, *Boring machines, Excavation, Drilling, Costs, Construction, Economics, Safety, Blasts, Vehicular tunnels, Mining, Costs comparisons, Rock excavation, History, Construction costs.
Identifiers: Blasting.

Tunnel construction data from 1955-1965 are reviewed to establish particular characteristics of the past-tunneling market. These characteristics include: (1) total footage of tunnel construction completed each year; (2) a breakdown of these tunnels according to use (water transportation, vehicle tunnels, railroad and subway tunnels, and mining tunnels); and (3) a profile of the 1955-1965 tunneling according to unlined-tunnel diameter and tunnel length. These data provided a history of tunneling activity and growth rates, used in conjunction with expert opinions and announced future tunneling expectations, to develop a forecast of 3000 mi of worldwide-tunneling activity from 1966-1976. To estimate the impact of tunneling machines on the total market, a detailed cost analysis is outlined for drill and blast vs mechanical boring. The economic comparison showed tunneling machines to be an effective economic alternative in a significant portion of future tunneling. Estimates indicate that tunneling machines will complete 1000 mi of the 3000 mi forecast between 1966 and 1976. Reasons for this estimate are: (1) lowest total-tunnel costs, (2) development of tunneling machines in the next 10 yr, (3) safety, (4) standardization of tunnel sizes, and (5) faster advance rates. (USBR)
W69-02598

THE INFLUENCE OF UNCERTAINTY IN STREAMFLOW ON FIRM POWER COMMITMENT IN HYDROELECTRIC POWER SYSTEMS,
Stanford Univ., Calif.
For primary bibliographic entry see Field 06A.
For abstract, see .
W69-02616

SOME COMMENTS ON REGIONALIZATION IN HYDROLOGIC STUDIES,
Geological Survey, Arlington, Va.
N. C. Matalas, and E. J. Gilroy.
Water Resources Res, Vol 4, No 6, pp 1361-1369, Dec 1968. 7 ref.

Descriptors: *Markov processes, *Statistical methods, *Streamflow forecasting, Synthetic hydrology.
Identifiers: Regionalization.

In synthetic hydrology, regionalization of the estimates of the historical parameters at a number of gaged sites in a river basin, via regression analysis, with physiographic and meteorologic characteristics of the basin is proposed as a means of facilitating the reduction of operational bias, the difference between historical parameters and their respective population values. In effect, regionalization attempts to extend the lengths of the historical sequences by means of the spatial variation inherent among the historical sequences. The regression relation provides a means of estimating the parameters at ungaged sites, thus permitting synthetic sequences to be generated at these sites. At the jth site, a choice must be made between y sub i, a statistical characteristic of the observed flows, and bar y sub i, a regionalized estimate of the characteristic, for use in the model for generating synthetic flows at the jth site. The regional estimate is obtained from a regression of y on a set of basin characteristics. If regionalized V sub jj/ V sub jj is smaller than (2 - rho prime), then regionalized y sub i instead of y sub i is used in the generating model, where regionalized V sub jj and V sub jj are the variances of regionalized y sub i, respectively, and rho prime is a measure of the interstation correlations. This criterion is shown to be independent of the jth basin characteristics. The criterion is a function of the jth basin characteristics if the data at the jth site are not used in developing the regression relation. For an ungaged site, regionalized y sub i may be obtained with variance that depends upon the basin characteristics at the jth ungaged site. (Knapp-USGS)
W69-02667

8D. Soil Mechanics

SAND COMPACTION WITH VIBRATORY ROLLERS,
Massachusetts Inst. of Tech., Cambridge; and D'Appolonia (E.), Consulting Engineers, Inc., Pittsburgh, Pa.
D. J. D'Appolonia, R. V. Whitman, and E. D'Appolonia.
Amer Soc Civ Eng Spec Conf, Cambridge, Mass, Aug 1968. 46 p, 19 fig, 2 tab, 20 ref, append.

Descriptors: *Compaction, *Compaction equipment, Bibliographies, *Soil compaction, Compaction tests, Vibrators (Mechanical), *Rollers, Relative density, *Sands, *Dune sands, Granular materials, Rolling, Density, Soil dynamics, Lifts (Construction), Soil mechanics, Damping.
Identifiers: *Vibratory compaction, Vibration tests, At rest pressure.

Smooth-drum vibratory rollers were used to surface-compact a poorly graded dune sand. The compactive effort was ineffective at depths greater than 4-5 ft. Compacted density at any depth increases with the number of roller coverages but after about 5 passes, a large increase in the number of passes is required to achieve a significant increase in density. When sandfill is placed in lifts, the lift height should not be significantly less than the depth at which maximum compaction occurs for a single lift

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or much of the compactive effort will be lost through repeated overvibration of near-surface layers. Compacted density, ground acceleration, and dynamic stress increased with operating frequency. The roller-soil system appears to be highly damped for operating frequencies less than 30 cps, indicating that a clearly defined resonant frequency does not exist. Operating frequency should be as large as resonant frequency to obtain the most efficient use of the vibratory roller. Except at the surface, the most efficient compaction is achieved in the zone where minimum soil stress decreases to zero. Measurements of horizontal stress in vibratory compacted sandfill indicate that lateral stresses are significantly greater than the at-rest earth pressure. (USBR)
W69-02555

EXPLOSIVELY CONSTRUCTED DAM OF THE BAIPAZINSK HYDROCOMPLEX ON THE VAKHSH RIVER,
R. S. Ariel, O. A. Leont'ev, and A. L. Mariupol'skii.
Transl from Gidrotekh i Melior, No 7, pp 1-8, July 1968. Bur Reclam Transl 789, Oct 1968. 22 p, 9 fig, 4 photo.

Descriptors: *Foreign construction, Foreign projects, *Explosions, *Rockfill dams, Diversion dams, Charges (Explosives), Tunnels, Seepage, Irrigation systems, *River closures, Dam design, Irrigation canals, Dam construction, Explosives, Impervious blankets, Fines, Seepage losses, Construction.
Identifiers: USSR, Baipazinsk Dam (USSR), Vakhsh River (USSR), *Slide dams, *Explosive construction, Nurek Powerplant (USSR).

On March 29, 1968, a rockfill diversion dam, having a volume near 1.55 million cu m, was constructed by an explosion in the Vakhsh River Canyon at Baipazinsk, 30 km below Nurek Dam in the Tadzhik SSR. The explosive charge (1800 t) closed the channel without damaging the previously constructed spillway or tunnel and water was then diverted to the semi-arid Iavinsk-Obikiiksk valleys. The dam is one feature of a project to irrigate 40,000 ha of fertile land suitable for raising fine-fiber cotton. The project includes Nurek Dam to store water and generate power, a canal system (from 15 to 30 cu m/sec), pumping plants, 23 inverted siphons, 28 aqueducts, 7 high fill embankments, and more than 600 large hydraulic structures, all constructed on strongly slumping loessial soils. Constructing the dam explosively reduced construction time and costs, and both could have been excessive in the narrow canyon. To reduce the seismic effect, 3 groups of charges were detonated successively, then 30,000 cu m of fines were exploded to form an impervious blanket in the channel. When the head reached 24 m on March 30, seepage was 4 cu m/sec, and 2 of the 4 spillway gates were opened to release water downstream. Water began flowing through the tunnel by the middle of May. (USBR)
W69-02599

8E. Rock Mechanics AND Geology

APPLICATION OF PRINCIPLES OF ROCK MECHANICS TO BLASTING AND SUPPORT OF THE NORAD EXCAVATIONS,
Barodynamics, Inc., Georgetown, Colo.; and Corps of Engineers, Omaha, Nebr.
For primary bibliographic entry see Field 08H.
For abstract, see .
W69-02563

MEASURES OF THE DEGREE OF CHEMICAL WEATHERING OF ROCKS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia).
Bryan P. Ruxton.
J Geol, Vol 76, No 5, pp 518-527, Sept 1968. 10 p, 4 fig, 2 tab, 31 ref.

Descriptors: *Rocks, *Weathering, Chemical analysis, Tropical regions, Humid areas, Rock properties, Bibliographies, Leaching, Lava, Minerals, Chemical properties, Geologic investigations, Decomposition, Engineering geology, Petrographic investigations, Chemical stability, Igneous rocks, Silica, Kaolin, Geology.
Identifiers: *Rock weathering, Volcanic rocks, Aluminum oxides, Rock alteration, Pedology.

The degree of rock weathering in humid areas may be easily measured using silica-to-alumina mole ratios. The reliability of this index depends upon uniformity of the bedrock, consistency of alumina content during weathering, correlation between silica and total element losses, and the difference between silica-to-alumina mole ratios of fresh and thoroughly weathered rock. Total silicate analyses of fresh and derivative weathered rock from 64 nonquartz-bearing volcanic rocks in northeast Papua, and 48 igneous and metamorphic rocks from other humid areas, showed good correlation between silica and total element losses, and between the silica-to-alumina mole ratio and total element loss. The silica-to-alumina mole ratio also correlates well with the more complex absolute and relative weathering indices calculated from total silicate analyses. The silica-to-alumina mole ratio will be a useful guide to physical, chemical, and engineering properties of rocks; however, the index is less suitable for strongly seasonal savanna or more arid areas. (USBR)
W69-02565

STRENGTH OF ROCK-LIKE MATERIALS,
Swedish Detonic Research Foundation, Stockholm.
N. Lundborg.
Int J Rock Mech Mining Sci, Vol 5, No 5, pp 427-454, Sept 1968. 28 p, 38 fig, 1 tab, 76 ref, 2 append.

Descriptors: *Rock mechanics, Rocks, *Brittle failures, *Shear tests, Bibliographies, Pore pressures, Materials testing, Triaxial compression, Strength of materials, Rock properties, Test procedures, Test specimens, Underground structures, *Triaxial shear, Triaxial stress, Unconfined compression, Triaxial tension, Splitting tensile strength.
Identifiers: Coulomb-Navier model, Griffith theory, Foreign testing, Coulomb-Mohr criterion, Brittle fracture theory, Sweden.

The strength of brittle materials, such as rock, is greatly increased by external hydrostatic pressure. In underground structures and deep mines, the pressure is superposed with 1 or 2 principal stresses, and strength increases with depth. Rock strength in underground rooms also depends on the volume of excavation and internal pore pressures, implying that strength determinations are not simple. The strength of rock under triaxial stress conditions and the most common theories of brittle fracture are reviewed. Some methods of triaxial strength determination are described and results compared. The strength dependence of lateral pressure, pore pressure, and size of test specimen is discussed. Several standard test procedures are suggested for uniaxial, triaxial, and shear testing. The confined double shear test has been used for measuring the strength of Swedish rocks and ores. This is a simple arrangement, permitting shear tests at higher normal pressures, and has advantages in predetermining the rupture surface and increasing normal pressures to arbitrary values. (USBR)
W69-02573

DISTRIBUTION OF FORCES BETWEEN ROCK AND THE LINING OF A PRESSURE TUNNEL,
G. G. Khachikyan.
Hydrotech Constr, No 9, pp 801-804, Sept 1967. 4 p, 2 fig, 8 ref.

Descriptors: *Pressure tunnels, *Tunnel linings, Stress distribution, *Hydrostatic pressures, Stress relieving, Rocks, Rock mechanics, Foreign design practices, *Tunnel design, Pressure conduits, Penstocks, Cracks, *Pressure distribution, Fractures, Grouting, Radial stress.
Identifiers: Concrete linings, USSR, Joints (Geology).

A rock mass working conjointly with a tunnel lining under internal water pressure relieves forces in the lining. The intensity of relief largely depends on the strength and elastic properties of the rock. Pressure tunnel tests at the Amsteg hydropower development showed that sericite schists absorb 20-40% of the total internal pressure; similar tests at Dzora hydropower station showed that dacites take up 30-50% of the load. Stronger rock would ease the static working conditions at tunnel linings even more. In driving a tunnel, cracks are formed in the rock by stress redistribution and drilling and blasting operations. Radial displacements of rock in the disturbed region are greater than in the monolithic mass. The boundary of the jointed zone also depends on the pressure transmitted from the lining, which causes radial cracking in rock of low tensile strength. A mathematical method determines the relief factor for a circular pressure tunnel with a monolithic concrete lining. The relief factor depends on the elastic properties of rock and concrete, lining thickness, and the zone of fractured rock close to the excavation. Loading relief can be increased by reducing concrete lining, which is impracticable, or by grouting fractured rock. (USBR)
W69-02575

THE THREE MAJOR PROBLEMS IN ROCK SLOPE STABILITY IN CANADA,
Golder, Brawner and Associates, Ltd., Vancouver (British Columbia).
C. O. Brawner.
Prepr No 68-A-333, Soc Mining Eng AIME, Minneapolis, Minn, Sept 1968. 33 p, 13 fig, 17 ref.

Descriptors: Rock mechanics, Rock excavation, *Mining, Mines, Beds (Geology), *Slopes, Stability analysis, Blasts, Groundwater, Joints, Shear strength, Shear stress, Neutral stress, Fractures, Foreign design practices, Faults (Geology), Drilling, Economics, Safety, Engineering geology, Joints (Geology), *Slope stability, Bibliographies.
Identifiers: Blasting, *Open pit mining, Geologic defects, Canada, *Rock slope stability, Rock breakage.

As excavation depths in open pit mining increase and ore grades decrease, safety and economy in pit slope stability become increasingly important. Three important factors influencing slope stability are rock structure, ground water, and drilling and blasting programs. Examples of the influence of these factors on slope stability are given. Geologic, hydrologic, topographic, and climatic conditions, and mining programs differ at each mine. Each location must be evaluated individually, with the selection of the final slope design based upon actual site conditions. Stability of rock slopes in jointed, bedded, or faulted rock depends primarily on the orientation of mechanical defects. Ground water influences stability by creating seepage pressures resulting from friction flow losses; forces resisting sliding are reduced by the neutral pressure of cleft water. Shear stresses in the rock are increased by dynamic acceleration forces caused by blasting. Blasting also causes additional joints and fractures which reduce stability. (USBR)
W69-02593

8F. Concrete

FATIGUE OF WATER-SATURATED CONCRETE,
T. S. Karanfilov.
Hydrotech Constr, No 9, pp 798-800, Sept 1967. 3 p, 2 fig, 8 ref.

Descriptors: Concrete, Concrete structures, Concrete technoloby, Moist condition, *Concrete testing, *Saturation, *Fatigue (Mechanics), Cracks, Absorption, Internal friction, Materials

testing, Wet condition, Loads, Strength of materials, Hydraulic structures.
Identifiers: Microcracks, *Repeated loading, Foreign testing, *Cyclic loads, USSR, Fatigue tests, Concrete properties.

Many reinforced-concrete hydraulic structures are exposed to cycles of partial or complete water saturation. Data are lacking on the fatigue of concrete exposed to cyclic saturation. Laboratory tests show how the fatigue limit of water-saturated concrete varies with load cycles. The fatigue strength of saturated concrete is much lower than dry concrete, and appears to be independent of the type of stress for water-saturated and dry concretes. At this stage of investigation, absorption effects, cleaving effects of thin water films, softening of concrete, and leaching appear to be factors in the decreased fatigue limit for water-saturated concrete. Repeated loadings spread existing cracks and form new microcracks. Water entering the existing and incipient cracks spreads as a monomolecular film and increases stresses in the structural bonds of concrete by the absorption effect and cleaving action of thin water films, and diminishes internal friction. (USBR)
W69-02576

DETERMINATION OF THE STRENGTH OF CONCRETE FOR DIVERSION TUNNEL LININGS OF THE INGURI HYDROELECTRIC PROJECT,
Kh. E. Andguladze.
Hydrotech Constr, No 7, pp 645-648, July 1967. 4 p, 4 fig, 3 tab, 5 ref.

Descriptors: *Quality control, *Ultrasonics, Strength of materials, *Concrete control, *Concrete testing, *Tunnel linings, Tunnels, Concrete mixes, Diversion tunnels, Field control, Field tests, Foreign research, Correlation techniques, Sonic waves, Compressive strength, Measuring instruments, Instrumentation.
Identifiers: USSR, *Ultrasonic tests, Concrete properties.

The impulse ultrasonic method of investigating concrete strength was used on the diversion tunnel lining of the Inguri Hydroelectric Project. Three types of linings, all horseshoe-shaped with a raised crown, were used. The lining was partially reinforced, monolithic concrete. The impulse ultrasonic method establishes correlations between the propagation velocity of ultrasound and compressive strength of concrete of one specifice composition. Strength and uniformity of the concrete in the diversion tunnel lining were determined by an ultrasonic instrument using the method of longitudinal profiling; 3 schemes of exposure to ultrasonic waves were used, depending upon the structural member of the lining and technical possibilities. Part of the surface was exposed to slanting ultrasonic waves. This experience indicates that the impulse ultrasonic method of determining concrete strength in a tunnel lining is acceptable and fully reliable. (USBR)
W69-02580

PROVISION OF STRENGTH AND WATERTIGHTNESS IN THE CONTACT JOINT OF MONOLITHS OF BUILT-UP REINFORCED-CONCRETE ELEMENTS,
V. B. Safonov.
Hydrotech Constr, No 7, pp 611-616, July 1967. 6 p, 4 fig, 1 tab, 9 ref.

Descriptors: *Monoliths, Shear strength, *Joints, Reinforced concrete, Surface properties, Concrete technology, *Forms (Concrete), *Linings, Concrete placing, Adhesion, Precast concrete, Bondings, *Construction joints, Foreign research.
Identifiers: USSR, Form removal, Bond.

A method of providing strength and watertightness in the contact joint of monoliths of built-up reinforced concrete elements is discussed. Mechanical operations connected with surface preparation prior to making monolithic joints are eliminated. Preparation is accomplished during production by applying new types of light, removable forms--meshwork forms with burlap surfaces or metal-plastic forms. Open, removable meshwork forms are also used. To control water loss to form linings, the cells of the mesh are partially filled with a polymer during the manufacture of the metal-plastic. Removing form linings from the block surface does not require lubricants. As forms are removed, the surface cement film is stripped from the block surfaces and retained on the burlap or polymer covering. After forms are removed, the surface has a canvas-like appearance and roughness. Protecting the concrete surface will guarantee good watertightness and rupture strength nearly equal to that of monolithic concrete. Shear strength of the joint will be 60-80% of the corresponding monolith strength. (USBR)
W69-02581

8G. Materials

WELDING THE HIGH STRENGTH STEELS,
R. R. Irving.
Iron Age, Vol 202, No 10, pp 61-68, Sept 1968. 8 p, 4 fig, 3 tab.

Descriptors: Welded joints, *Welding, Arc welding, Steel, Fabrication, Steel plates, Steel structures, *High strength steel, Metallurgy, Yield strength, Metalwork, Fillers, Toughness, Heat treatment, Hardness, Heat, Electrodes, Structural steel.
Identifiers: Electroslag welding, Narrow-gap process, Welds.

The acceptance of new high-strength steels, with minimum yield strengths of 80,000 psi and higher, is largely dependent upon weldability. Weldability is so important to the success of a new high-strength steel, that it has become a cardinal parameter as important as temperability and hardenability. High-strength steels are not difficult to weld, but are different than lower-strength steels and require special considerations. The traditional approach of matching the chemistry of the filler to the base material does not solve the problem; the problem is more complex, and matching toughness stands out as a very important criterion. Experiences of several fabricators in using conventional and new welding methods are reviewed, including the stick electrode, cold wire Tig, narrow gap, submerged arc welding, electron beam, Mig fine wire, electroslag, hot wire Tig, and plasma welding. (USBR)
W69-02562

CORROSION OF METALS IN DESALINATION ENVIRONMENTS,
Dow Chemical Co., Freeport, Tex.; and Office of Saline Water, Washington, D. C.
C. F. Schreiber, O. Osborn, and F. H. Coley.
Mater Prot, Vol 7, No 10, pp 20-25, Oct 1968. 6 p, 9 fig, 1 tab, 9 ref.

Descriptors: Materials testing, Desalination plants, Demineralization, *Corrosion, Corrosion control, *Copper alloys, Metals, Test procedures, Metals testing, Test specimens, Environmental tests, Sea water, Oxygen content, Velocity, Temperature, High temperature research, Dissolved oxygen, pH.
Identifiers: *Corrosion tests, Corrosion resistant alloys, Corrosion environments, Corrosion resistance, Test results.

The Office of Saline Water is sponsoring a research program at Freeport, Tex, to obtain a full understanding of metal behavior under desalination environments. A small-scale unit duplicates desalination plant water conditions, including variables such as oxygen content, pH, temperature, and velocity. Corrosion behavior of metals is evaluated by examining metal coupons. The corrosion test system, test procedure, and test results on copper alloys are discussed. Test results indicate: (1) dissolved oxygen concentration has the greatest single and interactive effect on copper alloy corrosion in hot sea water; (2) velocity is not a major factor in low oxygen content water; (3) increased residence time decreases corrosion rate in a closed circulation system with oxygen content in the range of 20-100 ppb, and at lower oxygen contents, increased residence time increases corrosion; (4) all copper alloys have very low corrosion rates at oxygen levels less than 5 ppb; and (5) steady-state corrosion rates are achieved within several hours of exposure under low oxygen conditions. Future studies on copper alloys and other metals will include temperature and pH variables, and ultimately, higher brine concentrations. (USBR)
W69-02582

8H. Rapid Excavation

APPLICATION OF PRINCIPLES OF ROCK MECHANICS TO BLASTING AND SUPPORT OF THE NORAD EXCAVATIONS,
Barodynamics, Inc., Georgetown, Colo.; and Corps of Engineers, Omaha, Nebr.
Clifton W. Livingston, and Kenneth Lord.
Prepr No 68-AM-33, Annu Meet Amer Inst Mining, Met Petrol Eng, New York, N Y, Feb 1968. 55 p, 16 fig, 26 ref.

Descriptors: *Rock mechanics, Blasts, Excavation, *Supports, Geology, *Rock excavation, Instrumentation, Underground structures, *Rock bolts, Design criteria, Construction, Elasticity, Faults (Geology), Tunneling, Granites, Extensometers, Deformation, Bibliographies, Joints, Safety, Strain gages.
Identifiers: *Blasting, *Smooth wall blasting, *NORAD, Strain energy, Underground openings.

The NORAD Combat Operations Center, near Colorado Springs, Colo, contains large underground chambers excavated in pre-Cambrian granite at Cheyenne Mt. Part I of this paper reviews the construction history, identifies principles of rock mechanics applicable to blasting and rock bolting, describes some problems encountered, and explains the application of rock mechanics principles to their solution. The second part discusses rock mechanics instrumentation techniques used at NORAD. Blasting and rock bolting improvements are discussed in relation to the interdependence of blasting and support requirements. Successful excavation at a fault intersection of a 116-ft unsupported span joining 2 cylindrical openings, 73 and 63 ft in diameter, is attributed to: (1) soundwall blasting techniques capable of precisely controlling limits of excavation; (2) improvements in rock bolting capable of minimizing static elastic rebound; (3) a method and sequence of excavation designed to control release of elastic potential energy and, at final excavation limits, preserve the rock in its initial state; and (4) instrumentation capable of operating at any desired position, including close proximity to a blast, and accurately avaluating rock behavior at any instant as the work proceeded. (USBR)
W69-02563

EXPLOSIVELY CONSTRUCTED DAM OF THE BAIPAZINSK HYDROCOMPLEX ON THE VAKHSH RIVER,
For primary bibliographic entry see Field 08D.
For abstract, see .
W69-02599

09. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

ESTABLISHMENT OF WATER QUALITY LABORATORY AND SYSTEM FOR STORAGE AND RETRIEVAL OF INFORMATION,
South Dakota State Univ., Brookings.

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For primary bibliographic entry see Field 07C.
For abstract, see .
W69-02468

9D. Grants, Contracts, AND Research Act Allotments

FOURTH ANNUAL REPORT.
New Hampshire Univ., Durham.

Water Resources Research Center, Durham, N. H., August 1968. 87 p.

Descriptors: Water, Research projects, Progress reports, Accomplishments.
Identifiers: Annual report.

Progress reports for ten (10) research projects are given. Significant accomplishments for five (5) completed projects are identified. Several projects report progress on the problems related to lake eutrophication. Others report on the techniques and methodology for qualitative and quantitative measurement of viruses in surface waters and the rapid identification of organic compounds in water. The Center's involvement in State and Regional affairs is identified. (Byers-New Hampshire)
W69-02473

ANNUAL REPORT, 1 JULY 1967 to 30 JUNE 1968,
California Univ., Los Angeles.
A. F. Pillsbury.
Water Resources Center. Report no. 14 to OWRR, Sept, 1968. 60 p.

Descriptors: Water Resources Research, California.
Identifiers: California, Fresh Water Research program.

The history, organization, and activities of the University of California, Water Resources Center are reviewed, and the publications are listed. Reports are presented on the 65 projects that the Center had underway during the 1967-68 fiscal year. These vary from projects just being initiated to projects completed during the fiscal year. These projects are all in regular teaching departments on a number of the campuses of the University; the Center itself does not conduct research, but sponsors, coordinates and disseminates information from its research projects. 19 projects were in the Water Resources Policy and Planning category; 16 were in the Water Resources Development category; 13 were in the water Resources Utilization category; and 17 were in the Water Quality Control and Waste Management category. The reports, where definite information has been obtained, are informative but written in lay language. Copies are available on request. The program of the Center is in two parts: (a) the fresh water research program, and (b) the research on the desalting of sea water and brackish water. Since annual reports of the desalting research are prepared by the 'Sea Water Conversion Research Laboratories' in the Colleges of Engineering, Berkeley and Los Angeles, this activity is not included in this report.
W69-02474

ANNUAL REPORT OF THE RHODE ISLAND WATER RESOURCES CENTER, FISCAL YEAR 1968,
Rhode Island Univ., Kingston. Water Resources Center.
A. Ralph Thompson.
Annual Report to OWRR for August 1968, 113 pp.

Descriptors: *Rhode Island, *Annual Report, Water resources projects, Water Resources Board, Symposium, Master's degree program.
Identifiers: Annual Water Resources Report.

During the year ending Jund 30, 1968 the R. I. Water Resources Center was engaged in five projects involving the chemistry of water, four concerned with water quality, two with desalination of sea water, two with the properties of soils and one with aeration of water. The Center, through its coordinating committee, was responsible for drawing up an interdisciplinary master's degree program in Water Resources Engineering and Management. The Center followed closely the activities of the new state Water Resources Board in its first year of operation. On August 1, 1968 a symposium on Water Resources Research was held on the University of Rhode Island campus at which papers were presented on all projects supported by the Center under P.L. 88-379 from May, 1965 to June 30, 1967. (Author)
W69-02475

ANNUAL REPORT FOR FISCAL YEAR 1968 FOR THE VIRGINIA WATER RESOURCES RESEARCH CENTER,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
William R. Walker.
Annual Report to OWRR for Fiscal Year 1968, 90 pp, 4 fig.

Descriptors: Virginia, Water Resources Development.
Identifiers: Annual Report.

The activities of the Center and its director and a listing of the members of the advisory board are included in the report. Research projects for the year include predicting watershed yield in relation to type of bedrock, removing trace organics from water by adsorption on coal, biological and chemical study of Virginia's estuaries, treating dyeing bath wastes, slowing water surface evaporation with a monolayer, and effects of zooplankton on algae photosynthesis. New courses are described in the training and education section, and new staff members are listed. A breakdown of students in water-related fields includes the number of candidates for undergraduate and graduate degrees, the number of students by field of study, and type and status of employment of those graduated. Publications and theses for the year are also listed. (Shriver-Va Tech)
W69-02476

LOUISIANA WATER RESOURCES RESEARCH INSTITUTE--ANNUAL REPORT FOR FISCAL YEAR 1968.
Louisiana State Univ., Baton Rouge.

La Water Resources Research Inst, Ann Rpt to OWRR for Fiscal Yr 1968, Aug 1968, ii pp, 54 pp.

Descriptors: Groundwater recharge, *Underground storage, Limnology, *Chemical analysis, *Water reuse, *Mineralogy, *Streambeds, Manpower, *Economics, *Legal aspects.
Identifiers: Lake Pontchartrain.

All ongoing research and other activities administered by the Institute, regardless of funding, are described and summarized. The work includes a multidisciplinary study of measures to counteract salt-water encroachment in aquifers underlying Baton Rouge; economics of irrigation with municipal sewage plant effluent; point-bar geology of the Amite River; clay mineralogy of Lake Maurepas; and fresh-water storage in saline aquifers. Two new studies are: Limnology of Lake Pontchartrain and Manpower for the Water Industry. (Kazmann-LSU)
W69-02477

ANNUAL REPORT OF THE IOWA STATE WATER RESOURCES RESEARCH INSTITUTE FOR F. Y. 1968.
Iowa State Univ., Ames. Water Resources Research Inst.
Iowa State Water Resources Research Institute, Reports to OWRR, August 1968. 108 pp.

Descriptors: Water Resources Research, 1968 Annual Report.
Identifiers: P. L. 88-379, Allotment Projects, Matching Grant Projects.

This report summarizes the activities of the Iowa State Water Resources Research Institute. Gives brief descriptions of 19 research projects funded under P.L. 88-379 through U.S.D.I. Office of Water Resources Research. Contains references for 15 publications and 4 theses. The titles of the projects are: Economic factors in the establishment of water quality stream standards; Evaluation of flood damage to corn; Moisture movement to vertical sinks in water unsaturated soil; Recession characteristics of Iowa streams; Competitive recreational uses of selected Iowa lakes; Discharge-valley form relationships of selected Iowa streams; Biodegradability and the chemical oxidation of carbon adsorbed materials from effluents from sewage plants; Geology of the regolith aquifers of the Nishnabotna basin; Properties of tile drainage water; Influence of geohydrology on landscape and soil formation; The energy loss of flow around alluvial-channel bends; Reoxygenation of Iowa streams; Feasibility of fish production in tertiary waste treatment ponds; Economic analysis of alternative water pollution control measures; Groundwater seepage patterns to wells for unconfined flow; Assessment of costs among drainage districts; Economic implications of the permit system of water allocation; An economic analysis of organizations of water users.
W69-02478

1968 ANNUAL REPORT TO OWRR OF WATER RESOURCES RESEARCH INSTITUTE, OREGON STATE UNIVERSITY.
Oregon State Univ., Corvallis.

Water Resources Research Institute, August, 1968. 52 pp.

Descriptors: Hydrology, Limnology, Water law, Water institutions, Evaporation, Low flow, Economics, Water yield, Energy budget.

There were seven projects under the program 'Hydrology of Water Yield Prediction'--runoff from small streams, low flow prediction, energy and heat, water budget, soil and water movement, engineering hydrology, lysimeter. Water law, water diversion and an appraisal of water management institutions constituted a second major program. A third program concerned classifying and analyzing the status of Oregon's lakes. Total research needs were weighed in coordination with appropriate federal and state agencies. Director of the Institute is vice-chairman of the State Water Resources Board. Published seminar proceedings, research results, and a periodic newsletter were given wide distribution in the state. (Buckley-Oregon State)
W69-02479

WATER RESOURCES INSTITUTE, 1968 ANNUAL REPORT.
Texas A and M Univ., College Station.

Water Resources Institute, Texas A and M University, Report to OWRR, August 1968. 180 pp.

Descriptors: Education, *Water resources, Precipitation (Atmospheric), Runoff, Evaporation control, Hexadecanal, Octadecanal, Ecology, Optimization, Operations research, Evapotranspiration, Hydrology, Water rights, Irrigation, Mesquitos, Recharge, Economic prediction, Limnology, Estuaries, Operations research, Transpiration control.
Identifiers: Texas, Annual report, Hydrologic simulation, Groundwater pollution, Water institutions, Risk and uncertainty.

Progress in the research program in the Texas Water Resources Institute accomplished during the

period July 1, 1967 to June 30, 1968 is described. The report outlines the organization of the Institute and relates how the research program underway is directed to priority water problems in Texas. Brief reports are given on twenty-three projects. The report includes financial reporting on project costs. An educational survey is included. (Smerdon-Tex A and M)
W69-02480

FOURTH ANNUAL REPORT OF THE WATER RESOURCES RESEARCH INSTITUTE OF THE UNIVERSITY OF WYOMING,
Wyoming Univ., Laramie.
Paul A. Rechard.
Water Resources Research Institute, August, 1968. 78 pp.

Descriptors: *Allotments, *Grants, Instrumentation, Analytical techniques, *Contracts, Streamflow regimen, Game and fish, Ecology, Planning, *Water Resources Research Act, *Publications.
Identifiers: Annual Report.

Summary discussions of the work underway within the Water Resources Research Institute at the University of Wyoming are presented. The institute has an annual allotment program with the Office of Water Resources Research to study Criteria for Water Resource Planning, Bio-Physical Relationships in the Hydrologic Cycle, the Impact of Weather Modification and Principles of Analysis. Matching grants on varying water use and Game and Fish Resources are discussed. The report contains information on water resources education and training at the University of Wyoming and the relationships of the institute to the academic life of the campus and the public affairs of the State, and the publications of the WyoWRRI. (Author)
W69-02481

1968 ANNUAL REPORT TO OWRR FROM FLORIDA WATER RESOURCES RESEARCH CENTER,
Florida Univ., Gainesville.
Archibald O. Patterson.
lorida Water Resources Research Center, July 1968, 50 pp, 4 append.

Descriptors: Eutrophication, Lake morphology, Irrigation efficiency, Radioisotopes, Tracers intertidal areas, Bays, Tidal effects, Wind tides, Drought tolerance, Moisture stress, Plant physiology, Pesticide kinetics, Water use, Attitudes, Social values, Water analysis, Water law.

Seven ongoing research projects and three with 1968 starts are described. Areas covered in ongoing projects are eutrophication of Florida lakes; improving efficiency of irrigation methods in Florida to reduce water use; the use of radiometric methods in ground water studies; the behavior of water behind barrier islands when subjected to such variable stress as wind, tide, rain, and runoff; chemistry of plants when subjected to drought; preparation of a model state water-use code; mathematical model for predicting water use by population structure. New projects will deal with further studies of the use of radionuclides as tracers for hydrologic investigations; rapid water analysis methods; movement of pesticide solutions in soil. The report includes information on the training of water scientists at the University of Florida State University and describes recent efforts to encourage support of State water agencies in the research effort in Florida universities. (Author)
W69-02482

ANNUAL REPORT OF ACTIVITIES FOR FISCAL YEAR 1968,
Illinois Univ., Urbana. Water Resources Center.
Ben B. Ewing.
Annual Report No. 4, August 1968, 195 p.

Descriptors: Water resources, *Illinois.
Identifiers: Water resources research, *Annual report.

The University of Illinois Water Resources Center was established in 1963 to 'encourage and coordinate university-wide planning and implementation of interdisciplinary programs for research and graduate education in water resources.' Since designation as the Title 1 OWRR 'institute' for Illinois, the Center's activities have become Statewide. This report describes research accomplishments and other activities of the Center during Fiscal Year 1968 and also describes plans for the remainder of the calendar year. The Center's programs are sponsored both under Title 1 of P.L. 88-379 and from other sources such as State funds. The Center's Fiscal Year 1968 research program included a total of 29 projects of which 12 were included in the annual allotment from OWRR, 10 were partially sponsored by matching-grants from OWRR and 7 were sponsored with State funds. A progress report for each project is presented.
W69-02793

10. SCIENTIFIC AND TECHNICAL INFORMATION

ESTABLISHMENT OF WATER QUALITY LABORATORY AND SYSTEM FOR STORAGE AND RETRIEVAL OF INFORMATION,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 07C.
For abstract, see .
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